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Earth Observing System Earth Sciences Data & Information System (ESDIS) Project Level 2 Requirements Volume 0: Overall EOS Ground System Requirements

Volume 0

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Earth Observing System Earth Sciences Data & Information System (ESDIS) Project Level 2 Requirements Volume 0: Overall EOS Ground System Requirements

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Change Information Page

ISSUE	DATE	PAGES AFFECTED	DESCRIPTION
Original	02/18/93	All	Baseline
CH01	03/01/94	5-16	CCR 505-01-30-001
CH02	06/23/94	5-3, 5-4, 5-7	CCR 505-01-33-002
CH03	11/10/94	5-17	CCR 505-01-41-052 (Rescinded)
CH04	11/10/94	v, vi, 5-14, 5-15, 5-18, 5-19	CCR 505-01-3-003
CH05	06/12/95	ii, v, vi, 1-1, 1-2, 1-3, 2-1, thru 2-4, 3-1 thru 3-7, 4-1, 4-4, 5-1 thru 5-7, 5-12, 5-13, 5-17, C-1 thru C-5	CCR 505-01-30-004
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CH11	08/01/96	v, vi, D-5, D-7, D-8, D-9, D-10, D-11,13, D-14, D-15, D-16, D-20	CCR 505-01-30-009-A
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CH02	05/01/97	ii, iv, 2-3, 5-6, 5-7	CCR 505-01-41-143-E
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CH07	09/24/97	ii, iv, 5-6, 5-7	CCR 505-01-41-155-B
CH08	1/21/98	ii, iv, 4-4, C-1, C-6	CCR 505-01-30-017-A
CH09	1/21/98	ii, iv, D-3 through D-5	CCR 505-01-30-018
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2-6	Revision A	5-10	CH03	C-5	CH06	D-21	CH10
3-1	CH05	5-11	Revision A	C-6	CH08		

REFERENCES

[1] Global Change Data and Information System, A Draft Tri-Agency Implementation Plan, Version 1, 3/30/92.

[2] Science Data Plan for the EOS Data and Information System covering EOSDIS Version 0 and Beyond, Version 3.0, July 1994.

[3] EOS Reference Handbook, NASA Goddard Space Flight Center, March 1993.

[4] The Earth Sciences Data and Information Systems Project Program Data Management Plan Guidelines, GSFC, Draft, September 9, 1992

[5] Earth Observing System Output Data Products, Processes and Input Requirements, Version 3, ESDIS Science Office, April 1995.

[6] EOS AM Spacecraft Ground Support Equipment Requirements Document for Spacecraft Interface Simulator (STS), April 27, 1994.

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Section 1. Introduction

1.1 Scope

The requirements in this multi-volume document pertain to the Earth Observing System (EOS) Data and Information System (EOSDIS) and all its interfaces. EOSDIS serves several major roles within NASA's Mission to Planet Earth: 1) EOSDIS serves as NASA's Earth Science discipline data system for information management, archival, and distribution of NASA Earth Science data; 2) EOSDIS serves as NASA's portion of the evolving Global Change Data and Information System (GCDIS); and 3) EOSDIS provides the majority of functionality of the ground system supporting the EOS series of spacecraft. In support of these roles, EOSDIS has interfaces to currently existing and future ground systems for flights concerned with Earth sciences data, institutional support services managed by NASA, systems from other U.S. Government agencies and private organizations, ground systems provided by the International Partners, multiple EOS spacecraft, and user facilities. The organization responsible for implementing EOSDIS is the Earth Sciences Data and Information System (ESDIS) Project (ESDISP). The requirements in this multi-volume document represent the comprehensive set of requirements to be implemented by the ESDIS Project.

This volume of the document is the first of seven. This volume provides the necessary context for the EOSDIS, and is to be considered as a companion volume to all other volumes of this document. Each of the other volumes is incomplete without Volume 0. Unless specifically stated, the requirements contained in this volume are applicable to all aspects of the data and information system addressed in the other five volumes. Volumes 1 through 6 pertain to distinct functional components comprising the EOSDIS. Figure 1-1 graphically represents these components and all of EOSDIS's interfaces. It is annotated to show which volume of this document contains the requirements for a given component or interface.

1.2 Requirements Hierarchy

This section identifies the requirements hierarchy and document traceability that apply to the EOSDIS.

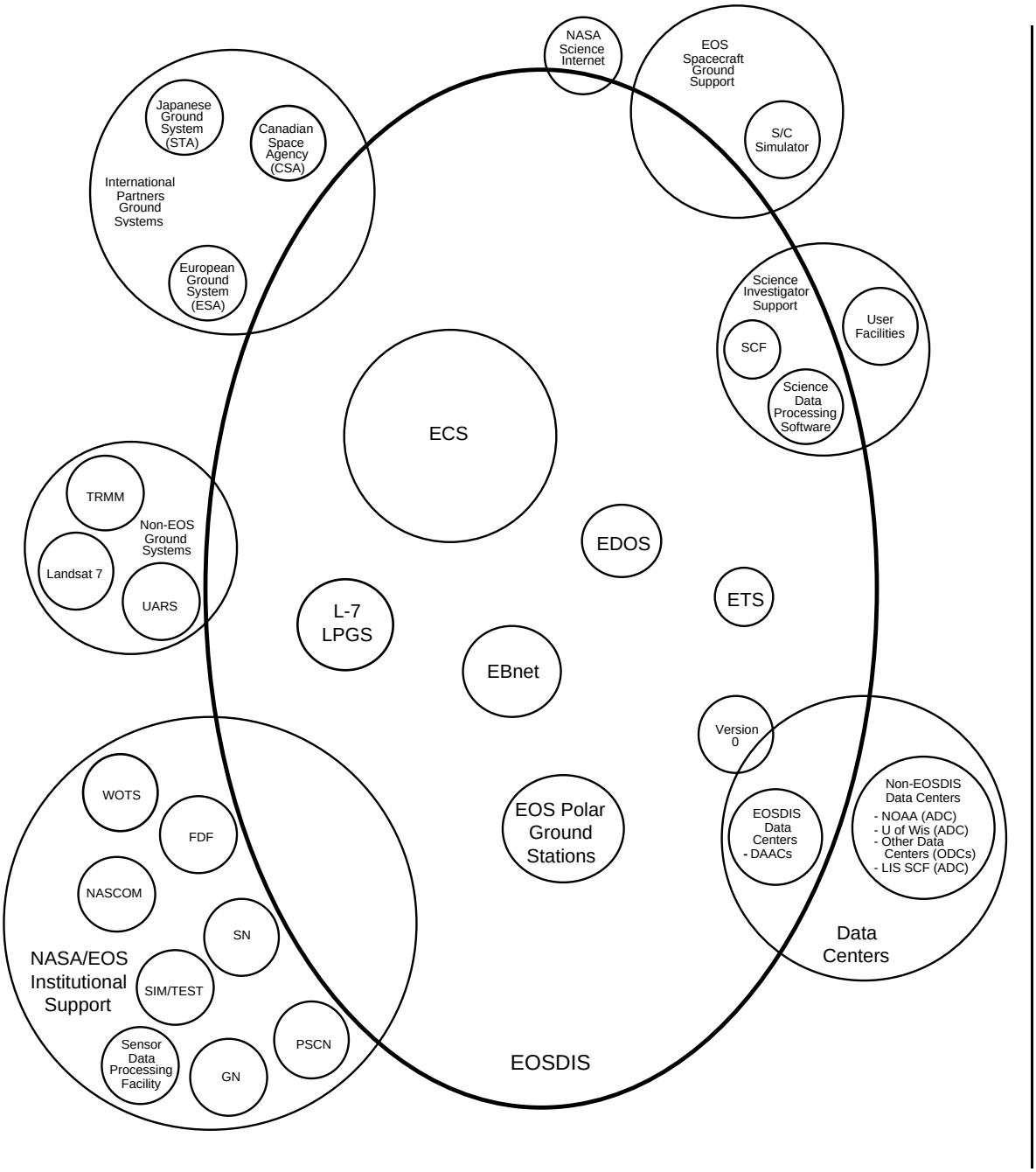
1.2.1 EOS Program Requirements

a. Execution Phase Project Plan for the Earth Observing System (EOS), March 1995.

b. EOS Mission Requirements Request (MRR) for the AM-1 Flight of the Earth Observing System (EOS), November 1992.

c. EOS Detailed Mission Requirements AM-1 Spacecraft, July 1995.

d. EOS Mission Requirements Request (MRR) for the PM-1 Flight of the Earth Observing System (EOS), July 1993.



CH04

Figure 1-1. Venn Diagram for EOSDIS and Its Interfaces

1.2.2 ESDIS Project Level 2 Requirements (Volumes 0 - 6)

a. ESDIS Project Level 2 Requirements, Volume 0: Overall ESDIS Project Requirements (This volume)

b. ESDIS Project Level 2 Requirements, Volume 1: EOSDIS Core System (ECS)

c. ESDIS Project Level 2 Requirements, Volume 2: EOS Data and Operations System (EDOS)

d. ESDIS Project Level 2 Requirements, Volume 3: Other ESDIS Project Requirements

e. ESDIS Project Level 2 Requirements, Volume 4: Code O Institutional Support Services

f. ESDIS Project Level 2 Requirements, Volume 5: EOSDIS Version 0

g. ESDIS Project Level 2 Requirements, Volume 6: EOSDIS Backbone Network (EBnet)

1.2.3 Referenced Requirements Documents

a. Functional and Performance Requirements Specification for the EOSDIS Core System latest version.

b. Earth Observing System (EOS) Data and Operations System (EDOS) Functional and Performance Specification latest version.

c. Earth Observing System Data and Information System (EOSDIS) Test System (ETS) Functional and Performance Requirements latest version.

d. Earth Science Data Information System (ESDIS) Project Mission Specific Requirements for the Landsat 7 Mission Level 1 Processing. CH04

Figure 1-2 provides a graphic representation of the relationship of the ESDIS Project Level 2 requirements to other higher and lower level requirements. Figure 1-3 shows the expansion of the Level 2 requirements into its various volumes, and shows the relationship of this document to the remainder of the volumes of the Level 2 requirements document.

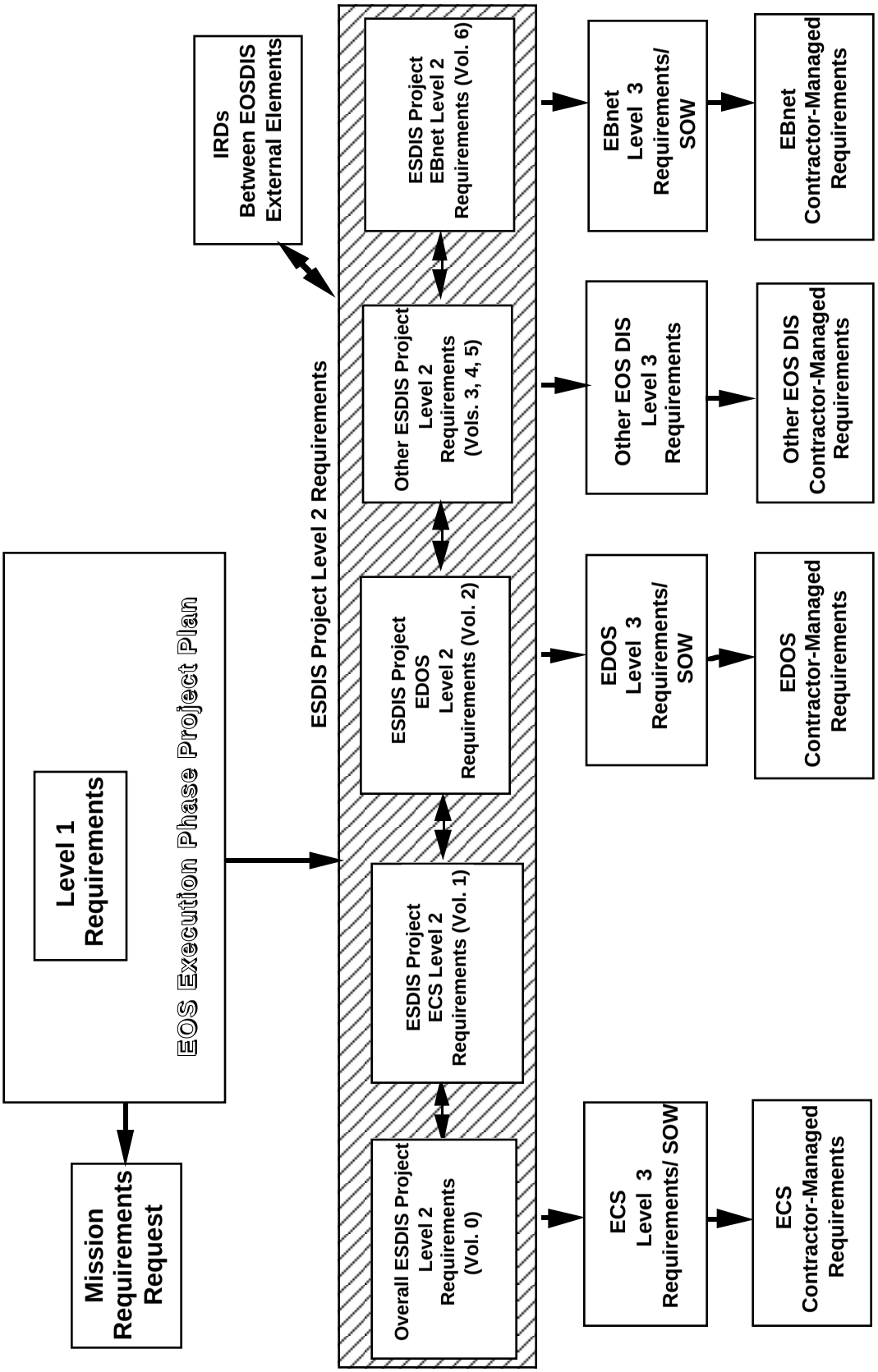


Figure 1-2. EOS Project Requirements Hierachy

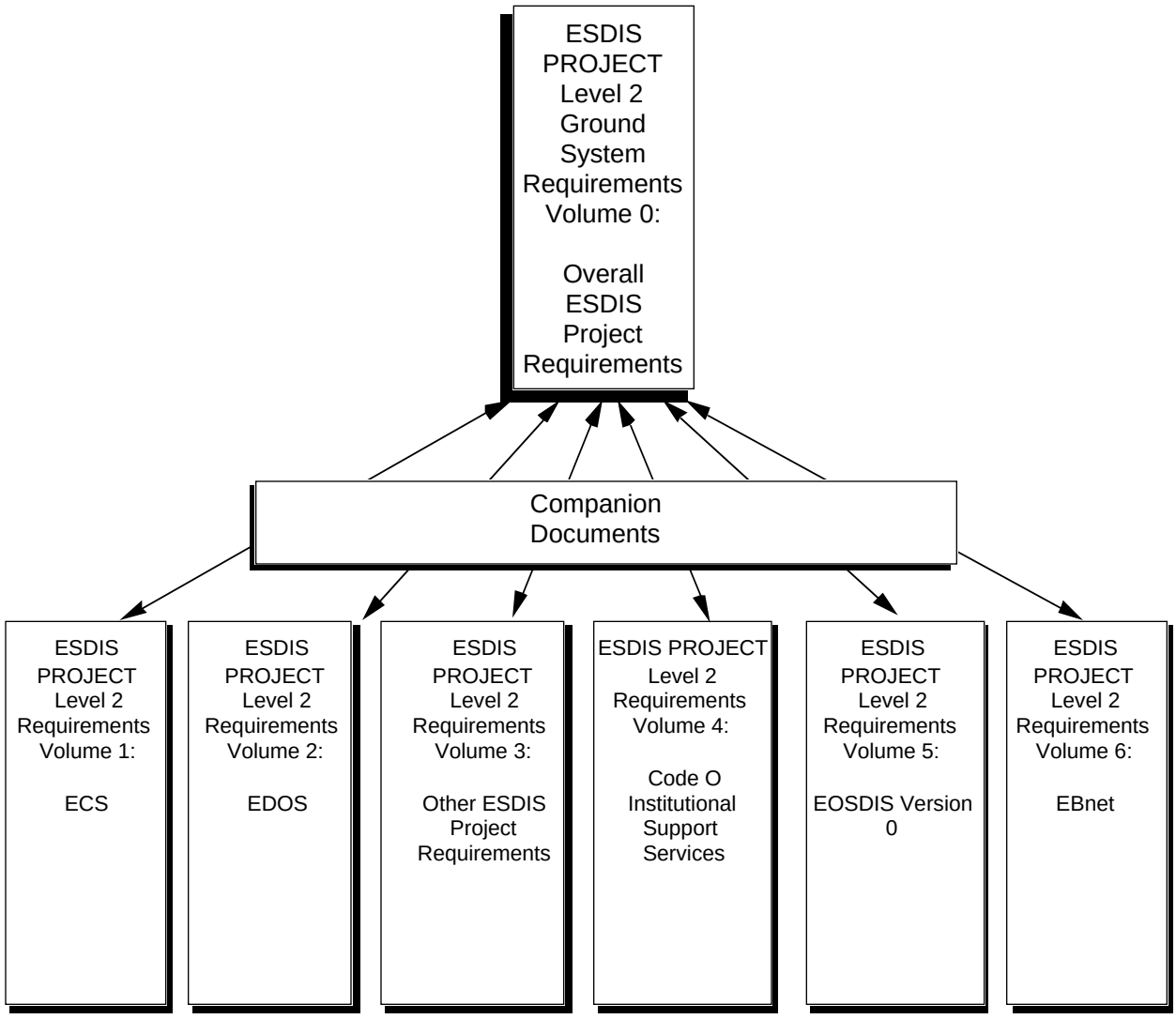


Figure 1-3. ESDIS Project Level 2 Requirements Document

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Section 2. EOSDIS Programmatic Context

2.1 Global Change Research Program And Mission To Planet Earth

The U.S. Global Change Research Program (USGCRP) is a major multi-agency Federal Government initiative focused on research to develop a predictive understanding of the global environment.

Mission to Planet Earth (MTPE) is NASA's primary contribution to the U.S. Global Change Research Program (USGCRP). Mission to Planet Earth is an evolutionary program, aimed both at providing important information on global change today, and at providing more comprehensive and detailed information over the next two decades. The MTPE includes, the EOS Program, a series of NASA-funded satellite missions (either underway or scheduled for launch prior to 1998), commercial satellite initiatives, U.S. instruments on-board international spacecraft, as well as ground-based field experiments and aircraft missions. Table 2-1 summarizes the objectives and launch date/status of all the initiatives currently comprising MTPE.

Central to the GCRP is the Global Change Data and Information System (GCDIS). It will allow users from any participating agency to have access to global change-related data archived by any of the other participating agencies. The GCDIS will provide for the management of data, the sharing and harvesting of information, the dissemination of ideas, and the establishment of a widespread community of collaborators for global change. A high-level architecture has been proposed for GCDIS in the document "A Draft Tri-Agency Implementation Plan, Version 1", (Reference [1]). This document is currently under review by cooperating GCDIS agencies and is being used as input to the development of an overall GCDIS Implementation plan.

As the major initiative in NASA's Mission to Planet Earth, the EOS Program will provide NASA's primary contribution to the GCDIS with its data and information system, called the EOSDIS. The EOSDIS will upgrade and interconnect selected existing data systems; perform limited generation of data products for pre-EOS flights; archive and distribute data from pre-EOS flights; generate program approved standard data products for EOS instruments; archive and distribute data products from EOS flights and from other MTPE observations; and develop interoperable links to other GCDIS agencies' data systems. All the data captured for Mission to Planet Earth will therefore be available to the GCDIS, and conversely, all the information within GCDIS will be available to EOSDIS. EOSDIS specific requirements in support of GCDIS will be defined after the GCDIS Agencies have defined and accepted a Final Implementation Plan. In addition to the functions that are contributions to the GCDIS, the EOSDIS will support forward and return link services for EOS spacecraft and instruments, will command and control EOS spacecraft and instruments, and will develop links to International Partner data systems contributing to the International Earth Observing Systems. CH04

Table 2-1. Objectives of Initiatives Comprising Mission to Planet Earth (1 of 2)

Agency	Satellites (Launch Date/Status)	Mission Objectives
ESA	ERS-1 (Operating) European Remote Sensing Satellite	High latitude climate-related parameters (e.g., sea ice, snow cover, glaciers)
NASA/Russia	Meteor-3 (August 1991) Total Ozone Mapping Spectrometer	Ozone mapping and monitoring
NASA	TOMS (Flights of Opportunity) Total Ozone Mapping Spectrometer	Ozone Mapping and Monitoring
NASA	UARS (Operating) Upper Atmosphere Research Satellite	Upper atmosphere constituents, structure, dynamics
NASA/CNES	TOPEX/Poseidon - (July 1992) Ocean Topography Experiment	Ocean surface topography and ice sheet altimetry
NASDA	JERS-1 (Feb. 1992) Japan's Earth Resources Satellite	High latitude climate-related parameters (e.g., sea ice, snow cover, glaciers)
NASA Data Purchase	SeaStar (August 1995) Sea-Viewing Wide Field Sensor (SeaWifs)	Purchase of ocean color data to monitor ocean productivity
ESA	ERS-2 (Early 1995) Earth Remote Sensing Satellite	High latitude climate-related parameters (e.g., sea ice, snow cover, glaciers)
NASA	Spacelab Series (Annually,1992-1997)	Solar output and properties of Earth's atmosphere
NASA	ERBS (October 1984) Earth Radiation Budget Satellite	Collect information about Earth Radiation Budget
NASA	NIMBUS-7 (October 1978) Total Ozone Mapping Spectrometer	Variety of instruments (e.g., SBUV, LIMS, and SMMR) for ocean color, and ozon mapping and monitoring
NASA/DARA	Spacelab Series (Oct 1993, Oct 1994, Mar 1996) Shuttle Imaging Radar/X-band Synthetic Aperture Radar	All-weather images of land surface vegetation geology, soil moisture
CSA/NASA	RadarSat (Early 1995) Radar Satellite	High latitude climate-related parameters (e.g., sea ice, snow cover, glaciers)
NASDA/NASA, CNES	ADEOS I (August 1996) Advanced Earth Observing Satellite	Global change measurements including visible and IR imagery scatterometry, atmospheric chemistry (Japan/ NASDA, joint with NASA and CNES)
NASA/NASDA	TRMM (November 1997) Tropical Rainfall Measuring Mission	Precipitation and related variables, plus radiation budget in lower latitudes (joint with Japan)
NASA/DoD	LANDSAT-7 (May 1998) Land Remote-Sensing Satellite	High spatial resolution visible and infrared to monitor land surface
NASA	EOS-AM Series (1998, 2004, 2010) Earth Observing System Morning Crossing	Global change measurements, including visible and near infrared imagery (nadir and bi-directional), radiation budget, measurement of CO and CH_4 (includes Canadian and Japanese instruments)

CH05

Table 2-1. Objectives of Initiatives Comprising Mission to Planet Earth (2 of 2)

Agency	Satellites (Launch Date/Status)	Mission Objectives	
Deleted			CH05
NASDA/NASA	ADEOS II (February 1999) Advanced Earth Observing Satellite	Global change measurements including visible and IR imagery, scatterometry, atmospheric chemistry	CH05
NASA	EOS-PM Series (2000, 2006, 2012) Earth Observing System - Afternoon Crossing	Global change measurements, including visible and near infrared imagery (nadir and bi-directional), radiation budget, and measure-ment of hydrologic cycle (includes Brazilian and Japanese instruments)	CH06
NASA	EOS-CHEM (2002, 2008, 2014) EOS Chemistry Mission	Atmospheric chemistry and ocean-surface scatterometry	
NASA/CNES	Jason-1 (2004, 2009) Radar Altimetry Mission	Study the ocean circulation	CH02, 05
NASA	LASAR ALT (2003, 2008, 2013, 2018) Lasar Altimetry Mission	Study the mass balance measurements of glaciers and ice sheets	
NASA	ACRIMSAT (Flight of Opportunity) (1999) Active Cavity Radiometer Irradiance Monitor	Monitor the variability of total solar irradiance	
NASA/RUSSIA	METEOR 3M-1 (August 1998) Stratospheric Aerosol and Gas Experiment	Retrieve global profiles, investigate the spatial and temporal variability of the measured species, characterize tropospheric and stratospheric aerosols, and provide atmospheric data	
ISSA	SAGE III (Space Station) (2001) Stratospheric Aerosol and Gas Experiment	Retrieve global profiles, investigate the spatial and temporal variability of the measured species, characterize tropospheric and stratospheric aerosols, and provide atmospheric data	
NASA	CERES (Flight of Opportunity) (2000) Clouds and Earth's Radiant Energy System	Generate data products that provide cloud-radiative and forcing feedback inputs to the climate system models and observational baseline of clear-sky radiative fluxes and radiative input to atmospheric and ocean energy models	
NASA	SOLSTICE (Flight of Opportunity) (2003) Solar Stellar Irradiance Composition Experiment	Measure the solar ultraviolet irradiance between 115 and 420 NM	
NASA	SAGE III (Flight of Opportunity) (2005) Stratospheric Aerosol and Gas Experiment	Monitor climate and ozone chemistry changes from mid-troposphere through mesosphere	
TBR	Aircraft (TBR)	TBD	
TBR	In-situ Field Experiments (TBR)	TBD	

2.2 EOS program

The purpose of the EOS Program is to provide the science user community with data and the supporting information system necessary to develop a comprehensive understanding of the way the Earth functions as a global system. This includes the interactions of the atmosphere, oceans, cryosphere, and biosphere, particularly as they are manifested in the flow of energy through the Earth system, the cycling of water and chemicals throughout the physical and biological systems. This comprehensive global study of physical, chemical, and biological processes in an integrated context has been termed Earth System Science, and is focused on the development of the capability to accurately predict the evolution of the Earth system on time scales of decades to a century.

The three main components of the EOS Program are:

a. An observing system (the EOS Space Measurement System - EOSSMS) to acquire essential, global Earth science data on a long-term, sustained basis and in a manner which maximizes the scientific utility of the data and simplifies data analysis.

b. An integrated scientific research program (EOSSRP) to investigate processes in the Earth System and improve predictive models.

c. A comprehensive data and information system (EOSDIS) to provide the Earth science research community with easy, affordable, and reliable access to the full suite of Earth science data from U.S. and International Partner (IP) platforms.

2.2.1 Space Measurement System

Sustained measurements are needed that result in globally analyzed products of established accuracy, so that changes can be documented. A benchmark for performance of the EOS Program will be the quality and reliability of measurements and analyses, as seen from a future perspective: What will investigators think, 20 years from now, when they are making similar measurements and trying to determine whether the apparent changes are real or are artifacts of instrument design, calibration, treatment of the data, or changes in an algorithm?

This component of EOS consists of five series of predominantly polar-orbiting spacecraft that will each collect data for 15 years and a purchase of ocean color data to monitor ocean productivity. The U.S. EOS spacecraft will be supplemented by European and Japanese EOS spacecraft. A detailed description of the spacecraft and instrument complements for the EOS Program is provided in the EOS Reference Handbook (Reference [4]).

The EOS instruments are divided into two classes, facility instruments and Principal Investigator (PI) instruments. Facility instruments are designed to measure variables useful to a wide range of scientific disciplines. Each facility instrument has a team of 10 to 24 scientists who develop and code algorithms to estimate geophysical and biological quantities from the signals measured by the sensors.

PI instruments are designed by small groups of scientists to make observations of more specific phenomena. Each PI instrument has a principal investigator, and might have several co-investigators.

2.2.2 Scientific Research Program

The Scientific Research Program focuses on the utilization of EOS data. It includes funding for postgraduate fellowships in the area of global change, for interdisciplinary investigators performing integrated studies of the Earth to enhance the capability to predict global change, and instrument investigations to focus on the development of and the utilization of data from particular instruments.

The Scientific Research Program is led by the science/user community. The scientists determine the observations to be made. Instrument engineering teams build the instruments to collect the data. The science teams plan and schedule the use of the instruments. The scientists provide the science algorithms for generating data products and performing quality assurance on the generated data products. They also analyze the data from the EOS instruments, publish the results, and make recommendations for the global change research community.

The EOS investigators supported by the EOSSRP include investigators associated with the PI instruments, Team Leaders (TLs) and Team Members (TMs) associated with facility instruments, the Interdisciplinary Investigators (IIs) associated with one or more instruments, and their co-investigators.

EOS interdisciplinary science investigations can be segmented according to two main themes.

1. The Earth System can be subdivided into several components: atmosphere, ocean, land biosphere, fresh water, snow and ice. From measurements with the EOS instruments, state variables associated with these various components can be estimated.

2. The cycles that link various parts of the Earth System can be identified: energy and momentum balance, hydrologic cycle, biogeochemical cycle, and ecosystem dynamics. Most of the interdisciplinary investigations address these links between components.

2.2.3 EOS Data and Information System

The EOSDIS supports the science objectives of the EOS Program. It does so in several ways. The EOSDIS will:

1. Be designed and implemented so it will support powerful new modes of research, facilitate synergistic interactions between data from the EOS instruments and simulations with models developed by EOS researchers.

2. Archive and provide access to usable scientific information to the geophysical, biogeochemical, ecological, and interdisciplinary communities, to be used by a wide spectrum of scientists and the public during the life of the EOS mission.

3. Archive and provide access to standard, reliable data products, essential to distinguish natural and anthropogenic variations, so that the scientific community will have access to independent measurements to validate and drive models of processes at local, regional, and global scales.

4. Support the command and control of EOS instruments and spacecraft.
5. Provide forward and return link services for EOS instruments and spacecraft.

Section 3. EOSDIS System Description

Figure 3-1 shows the EOSDIS ground system entities and boundaries. The EOSDIS, and all the interfaces shown inside the bold-lined ellipse in the figure, are under the management and technical direction of the ESDIS Project. Major components of the EOSDIS are the EOSDIS Core System (ECS), the EOS Data and Operations Systems (EDOS), the EOSDIS Backbone Network (EBnet), and the EOSDIS Ground Stations. Additionally, the ESDIS Project manages a working prototype that originates in existing facilities and capabilities, called the EOSDIS Version 0. Other parts of the EOSDIS include Distributed Active Archive Center (DAAC) facilities managing Earth science data and providing user support, CIESIN facilities supporting the policymaking community, science computing facilities (SCF) local to, and managed by, EOS investigators, science data processing software developed by EOS investigators, the EOSDIS Test System (ETS) capability, and the Level 1 Product Generation System for Landsat 7 (LPGS). EOSDIS interfaces to NASA Institutional Capabilities supporting the EOS flights. EOSDIS has external interfaces to the Global Change Data and Information System (GCDIS) data centers, to International Partner Ground Systems, and to non-EOS Ground Systems generating Earth Science data products. CH04 CH05

EOSDIS supports the following key functional objectives:

a. Unified and simplified means for obtaining and manipulating Earth science data

b. Prompt access to all levels of data and documentation concerning the processing algorithms and validation of the data, and to data sets and documentation that result from research and analyses conducted using the data provided by EOS

c. Provision for a distributed community of Earth scientists to interact with data sources and mission operations from their own facilities

d. Responsiveness to user needs

e. Evolution, growth and adaptation to new sources of data and new data system technologies.

f. Command and control of the EOS instruments and spacecraft.

The following sections provide a brief description of each of the components of the EOSDIS.

3.1 EOSDIS

3.1.1EOSDIS Core System (ECS)

The EOSDIS Core System (ECS) is the major component of the EOSDIS. The ECS will provide the planning and scheduling, command and control, data processing and management, networking, and data distribution functions required to support EOS operations and user access of EOS data. In addition ECS will provide archiving and data distribution and selected data

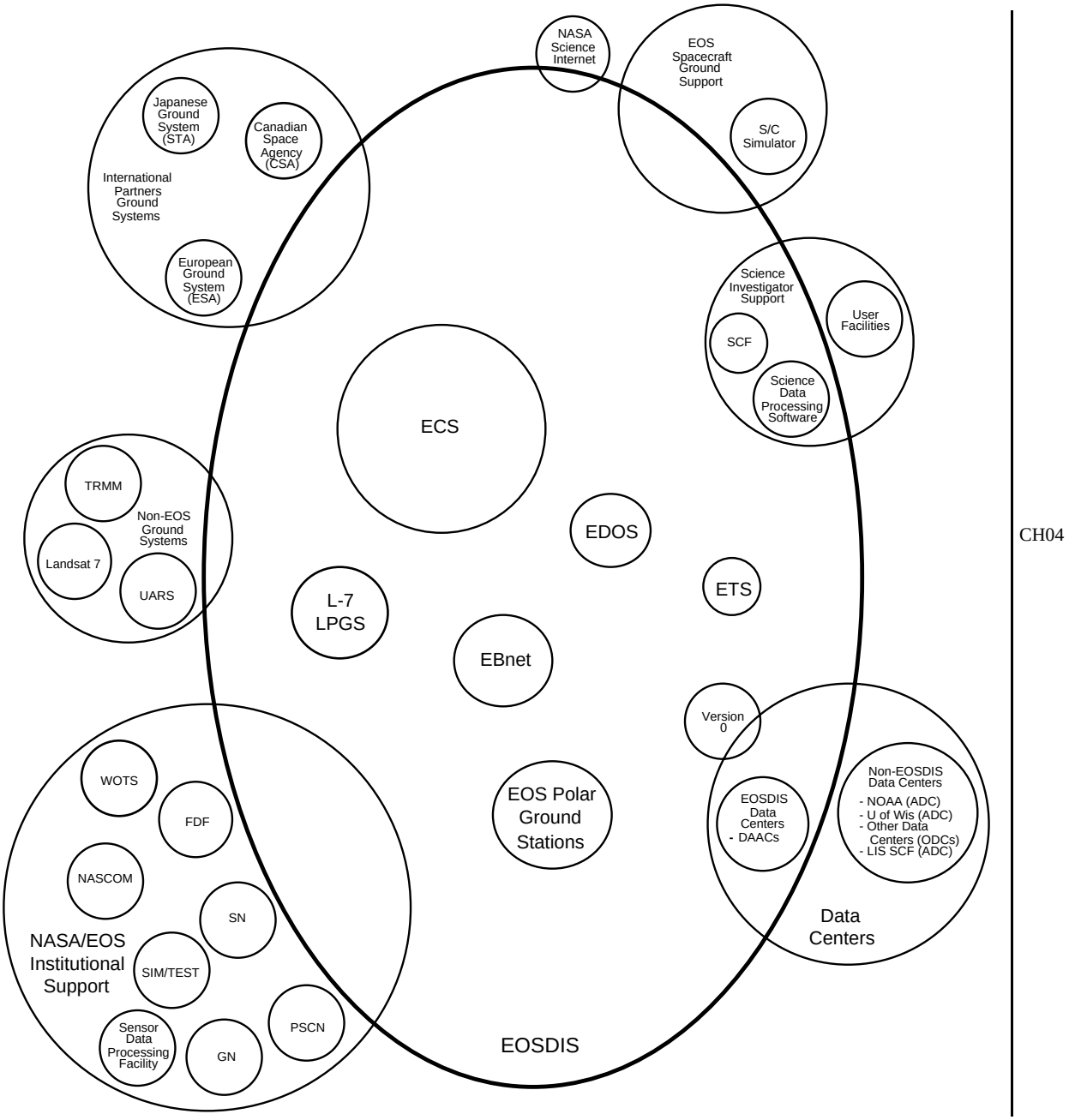

Figure 3-1. Venn Diagram for EOS Ground System Entities and Boundaries

processing for non-EOS Earth science data. The ECS will utilize, wherever possible, functionality and facilities of institutions and organizations external to EOSDIS where such utilization will enhance EOSDIS capabilities. This external support, provided largely by NASA institutional services, includes such facilities and resources as the Space Network (TDRS, TDRSS Ground Terminals, NCC), the FDF, NASCOM, the ground stations located at Wallops Island, VA, Alaska, and Norway. CH05 CH01

3.1.2 EDOS/EBnet

3.1.2.1 EDOS

The EOS Data and Operations System (EDOS) provides ground interfaces between the EOS spacecraft, the Space Network/TDRSS or EOSDIS Ground Terminals, and the EOS Ground system. It provides forward and return link services. The forward link services include:

a. Handling real-time command and control data (from the EOS Operations Center) (EOC)

b. CCSDS protocol processing

c. Delivering data to ground terminals for uplink to EOS spacecraft.

The return link services include near real-time services and "average rate" services: The near real time services provided by EDOS are:

d. Receive and capture return link data

e. Process real-time and playback data to remove artifacts

f. Perform rate buffering

The "average rate" services provided by EDOS are:

g. Separate packets by instrument

h. Arrange packets in chronological sequence

i. Remove redundancies

j. Perform quality checks

k. Create and provide back-up archive for Level 0 datasets

l. Transmit Level 0 and expedited datasets to appropriate DAACs

3.1.2.2 EBnet

The EOSDIS Backbone Network (EBnet) provides all necessary communications circuits and facilities between EDOS and various other elements of the EOS ground system for spacecraft scheduling, maintenance, control and coordination. It also provides operational telecommunication support for delivery of Level 0 and expedited data.

3.1.3 EOSDIS Version 0

EOSDIS Version 0 is an early "working prototype" of selected EOSDIS functionality. It will interconnect existing data systems at the DAACs via electronic networks, integrate catalogs, and introduce common data distribution procedures to ensure better access to data. As a "working prototype", Version 0 is not intended to have all the functional capabilities, fault tolerance, or reliability provisions of the EOSDIS Version 1. It will, however, be made available to be used and evaluated by the users to provide feedback regarding the required functional capability of the EOSDIS.

3.1.4 EOSDIS Data Centers

There are currently nine EOSDIS data centers identified. Eight of the data centers are called Distributed Active Archive Centers (DAACs). Each of the DAACs generates, archives, and distributes Earth science data sets. The data center at the CIESIN Data and Research Center (CDRC) is called a Socioeconomic Data and Applications Center (SEDAC). The SEDAC generates, archives, and distributes data sets supporting policymaking decisions regarding human dimensions of global change. Section 5, Table 5-1 summarizes each EOSDIS data center's discipline and data responsibilities at the instrument level. The specific data product requirements for each instrument at each center are provided in Reference [2].

3.1.5 Science Investigator Support

3.1.5.1 Scientific Computing Facilities

Scientific Computing Facilities (SCFs), located at science investigator facilities, are used to develop and maintain algorithms, produce data sets, validate data, and analyze and synthesize EOS and other data to expand knowledge about the Earth System and its components. The interface and algorithm toolkits necessary to support these activities are provided by the EOSDIS Core System. Some SCFs may support an Instrument Support Terminal (IST) toolkit provided by the ECS to support planning and scheduling of instruments. Also scientific quality assurance of EOS data products is performed at the SCFs of investigators responsible for those products.

3.1.5.2 Science Data Processing Software

Software for EOS standard science data product generation will be developed by the science investigators responsible for those products at their facilities. Investigator-developed software and algorithms for EOS standard products are integrated with the ECS and installed at the DAACs for routine production. Special products will be produced at the investigator facilities. Investigator-developed software and algorithms for EOS special products that become community accepted will become standard products through an Investigator Working Group (IWG) determined assessment, and later become integrated into the production environment at the DAACs.

3.1.5.3 User Facilities

EOSDIS users also include those facilities and organizations not participating directly in the EOS Program. These users include users of other NASA data systems and archives, other government data systems and archives, university research users, international investigators/data centers and

commercial data systems. Users within the education and policy community would be served by CIESIN. These users may acquire ECS-provided toolsets permitting them search, data order, and data manipulation, as would any EOS investigator. Hardware will not be supplied, however.

3.1.6 EOSDIS Test System (ETS)

The ETS has as its primary objectives to serve as an early and reliable source of CCSDS data during the EOS development effort; to support all phases of EOS ground system testing concerned with flight operations. It is intended to provide an independent testing tool; to provide a capability to quickly identify EOS data system failures; and provide near-term and future test support of evolving EOS test requirements.

3.1.7 EOS Polar Ground Stations

For AM-1, the EOS Polar Ground Stations (EPGSs) will provide backup space/ground communications. Ground station functions for Radio Frequency (RF) support beyond the AM-1 timeframe are currently planned for commercialization. This commercialized service will provide CH05
the primary space/ground communications services between the EOS spacecraft (except AM-1) and the EOSDIS and will also interface with the EDOS ground station interface and the EBnet Telecommunication system. The commercialized RF ground terminal service provides space-to-ground-link communication channels for receipt of high rate science data, receipt of spacecraft telemetry data and transmission of spacecraft commands for two EOS spacecraft simultaneously, including X-Band and S-Band capabilities. The EDOS ground station interface monitors and captures the high rate science data and transfers captured data to the EDOS level zero processing facility at GSFC. The EBnet telecommunication system consists of equipment to establish the connection to leased telecommunication services.

3.1.8 Level 1 Product Generation System for Landsat 7 (LPGS)

The LPGS will perform production level 1 processing of Landsat 7 ETM+ data. The LPGS will be located at the USGS EROS Data Center (EDC) in Sioux Falls, South Dakota, and will interface CH04
with ECS components installed at the EDC DAAC. Landsat level 1 products will be produced on demand by the LPGS, distributed by the EDC DAAC.

3.2 EOSDIS External Interfaces

3.2.1 Spacecraft Ground Support

3.2.1.1 Spacecraft Simulation

The Spacecraft Simulation provides ground-based simulation capabilities of the EOS spacecraft Command and Data Handling subsystem. The simulation capabilities support EOS-AM ground system test and training activities and include; support for training control center operators, testing operational procedures and spacecraft anomaly solutions, support for verification of end-to-end ground systems interfaces, and hosting of spacecraft mission and simulation software [discussed in reference 7].

3.2.2 Non-EOSDIS Data Centers

In addition to the EOSDIS data centers that are part of the EOS Program (i.e., CIESIN and the eight DAACs identified in Section 5, Table 5-1), there are several non-EOSDIS data centers with which agreements will be made. These Affiliated Data Centers (ADCs), which include several of NOAA's data centers, and the MSFC LIS SCF will provide access to non-EOSDIS data or to non-EOSDIS services required by the EOS Program. They will also receive selected EOS data sets from the EOSDIS data centers. As the GCDIS system evolves and other non-EOSDIS data centers become part of GCDIS, interoperability with these centers will become available to users.

3.2.3 NASA Science Internet (NSI)

EOSDIS is supported by several communications networks. The major network is the NASA Science Internet. This organization provides Internet access (including NSI, National Science Foundation Network (NSFnet), National Research and Education Network (NREN), etc.) to science users for accessing EOSDIS data, EOSDIS services, and each other. Selected EOS investigators will be connected to the Internet as part of EOSDIS. Any other user may get similar access to EOSDIS and the EOS science users by obtaining Internet connectivity. It is also via the NSI that EOSDIS will establish connectivity with additional Science Computing Facilities, Affiliated Data Centers, and International Partner (IP) Data Centers.

3.2.4 International Partner (IP) Ground System

International Partners will fly their instruments on EOS platforms. These instruments are: ASTER, provided by Japan, flying on EOS AM-1; Advanced Microwave Scanning Radiometer (AMSR-E), provided by NASDA, and Humidity Sounder for Brazil, provided by the Brazilian Space Agency, both flying on the EOS PM-1 spacecraft; Measurements of Pollution in the Troposphere (MOPITT), provided by Canada, flying on the EOS AM series; and Ozone Dynamic Ultraviolet Spectrometer (ODUS), provided by Japan, flying on EOS CHEM-1. For these instruments EOSDIS must interface to the IP Ground System to coordinate payload planning and integration, mission management, and payload command and control as well as processing and the exchange of data and information. Japan will provide planning and scheduling of their instrument on U.S. spacecraft from Japan. The control of CSA instruments on U.S. spacecraft is performed at GSFC. These centers will interface with the EOC and DAACs in accordance with joint agreements between NASA and each of the relevant IPs. CH06 CH06

In addition, the International Partners and NASA have agreed to make data available from ADEOS (Japan), EOS (NASA/U.S.), POEM (ESA), TRMM (NASA and Japan), and POES (NOAA/U.S.) to users. The IP MOUs will define the overall relationship between NASA and the IP for access and exchange of these data. CH06

3.2.5 Non-EOS Ground Systems

As part of NASA's Mission to Planet Earth initiative, Earth science data from non-EOS projects will be archived and distributed by the EOSDIS. The ground systems for these non-EOS projects will interface with the EOSDIS. Section 5, Figure 5-1 presents all these flights, identifying which version of EOSDIS would support them and, more specifically, which DAAC(s) would be responsible for the data.

For example:

- UARS data will be ingested, once available to the general public, into the GSFC DAAC.
- TRMM data, for other than CERES and Lightning Imaging Sensor (LIS), will be produced by the TRMM ground system and archived and distributed by EOSDIS by the GSFC DAAC. CERES on TRMM will be produced, archived, and distributed by EOSDIS at the LaRC DAAC. LIS on TRMM will be produced, archived, and distributed by the MSFC LIS SCF.

- Landsat 7 level 0 data products produced by the Landsat Processing System (LPS) will be archived and distributed by the EDC DAAC. Landsat 7 level 1 data products will be produced by the LPGS and distributed by the EDC DAAC. CH04

Each of the interfaces between a non-EOS ground system and EOSDIS will be defined by an IPA (Inter-Project Agreement) as each non-EOS ground system is designed. Plans for transition of data from the non-EOS projects will be defined in a Project Data Management Plan, prepared by the non-EOS Project with support from the relevant DAACs.

3.2.6 NASA Institutional Support CH05

NASA Institutional Support consists of several space and ground system elements which provide generic services to various projects, of which EOS is one, plus services unique to each project as required. Following is a summary of the elements included in NASA Institutional Support, and a very brief summary of the services each provides. CH05

Table 3-1. Summary of NASA Institutional Support

NASA Institutional Support	Summary Of Services	
Space Network (SN): TDRSs, TDRSS Ground Terminals (TGTs), Network Control Center (NCC)	Space and ground communications and tracking services; scheduling for TDRSS support	
Flight Dynamics Division (FDD)	Predicted and refined orbit, attitude, and navigational computational support services for the spacecraft	
NASA Communications (NASCOM)	Communications and data transport services between ground located elements; and communications support for end-to-end spacecraft simulations and training	CH05
Deleted		CH01, 05
Wallops Orbital Tracking Station (WOTS)	Provides backup tracking, telemetry, and low-rate commanding suport for AM-1 in case of TDRS malfunction; Provides primary tracking and telemetry support for Landsat 7 and later missions.	
		CH01*
Program Support Control Network (PSCN)	Backbone between NASA facilities for programmatic communications	CH05
Deleted		
Sensor Data Processing Facility (SDPF)	Data acquisition, data storage, Level 0 processing, and data distribution for selected missions	
Simulation & Test Facilities (Compatibility Test Van (CTV), Simulation Operations Center (SOC), Radio Frequency Simulation Operations Center (RFSOC))	Provide for testing of space to ground and ground functions	

Section 4. Overall Approach To The EOSDIS Development And Implementation

The implementation of the EOSDIS will be conducted using an evolutionary development approach. This approach is envisioned as a step-by-step process that will allow the graceful transition of the system from the existing Earth science-related data and information systems to the full-scale EOSDIS configuration.

EOSDIS prototyping and special studies are an integral part of the EOSDIS development approach. As shown in Figure 4-1, focused prototypes and special studies conducted by the ECS, EDOS, and EBnet contractors, by DAAC development teams, by universities, and industry are the foundation supporting EOSDIS phased incremental releases and operational deliveries.

This approach is an adaptation of the more customary evolutionary development model. In this approach, an operational capability is built in stages. Each stage consists of an expanded increment of the operational system. Directions in evolution are determined by operational experience. This allows and enhances convergence by the system developer and the system user to an appropriate operational capability. The approach incorporates prototyping as a means of communicating with the user to obtain accurate and timely requirements specifications. Successive stages refine user requirements by presenting the user with prototypes of the proposed system or prototypes of components of the proposed system. The approach works well where the user is unsure of or unable to articulate system requirements or the users needs change along with changing technologies. Change may originate from many sources, for examples from lessons learned from previous releases, from new concepts tried out in prototypes, from continuous iteration with the science user community to solicit their input and feedback, and from innovation originating in the general earth science and computer technology communities not necessarily directly associated with EOSDIS.

The ESDIS Project refines the customary evolutionary model by creating two evolutionary "cycles". One cycle (the upper timeline in Figure 4-1) is planned to a longer development schedule and produces large operational deliveries that are formally released to users. This "operational" cycle is driven by the need to implement operational systems available in time to support critical EOS needs (such as spacecraft launch). It accommodates change over a longer time scale as a phased incorporation of proven technologies and accepted user-sensitive designs into an evolving operational capability. The operational cycle provides formal documentation during the development of each operational release. This provides the development rigor and documentation needed by the Independent Verification and Validation (IV&V) and system maintenance activities.

The rigor applied in the operational cycle, which is appropriate for a large system development, avoids the "code and fix until you get it right" philosophy inherent during prototyping.

The other cycle (the lower timeline in Figure 4-1) supports a "faster" prototyping pace that addresses many more focused issues. This "prototyping " cycle addresses functions having

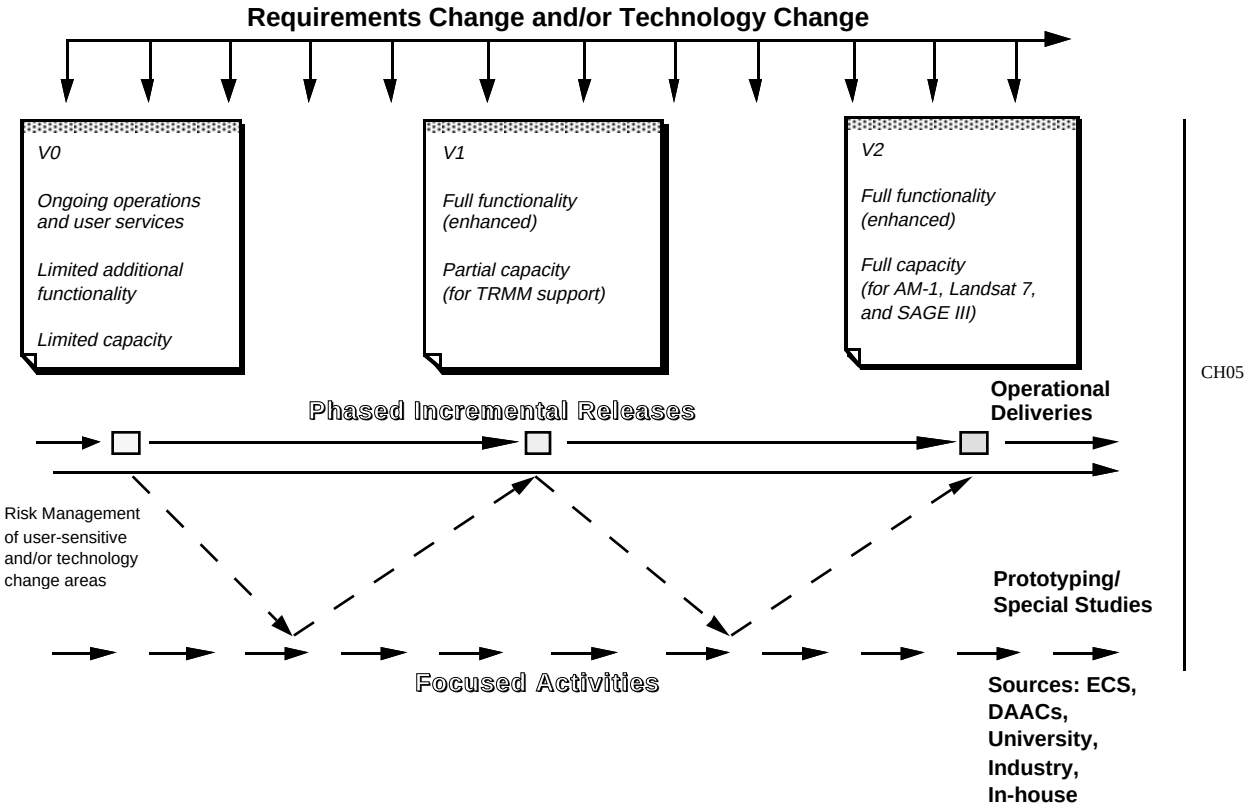

Figure 4-1. EOSDIS Development Cycles

significant uncertainty in their requirements, functions with high user sensitivity, or functions enhancing the basic requirements. It addresses high risk activities, explores technology alternatives, and forms a bridge between external research and development and operational capability. Development formality varies depending on the pay-off and complexity of the prototype. High pay-off prototypes that are likely to become operational will be more formal than prototypes aimed at increasing understanding of complex functional areas.

The flexibility supported in the prototype cycle allows sufficient room for exploration and evaluation of requirements and capabilities. These advantages offset the increased cost associated with managing and conducting two development cycles.

Figure 4-1 also shows the first three operational EOSDIS versions. In the figure, the terms "partial" and "limited" are comparisons relative to the final, fully functional EOSDIS. Version 0 (V0) will maintain on-going operations and user services. While it will add some functionality and capacity to capabilities currently available at the DAACs, Version 0 will emphasize user sensitive areas and the technology needed to support this emphasis. EOSDIS Version 1 (V1) will provide the functionality and capacity required for TRMM support. It will be built on V0 at the DAACs that are responsible for supporting the TRMM mission. It will address technology and data volume issues and provide the capacity needed to hold the data available prior to the launch of EOS satellites. Version 2 (V2) enhances Version 1 functionality and expands capacity to the level

CH05

CH05

needed to support EOS AM-1, Landsat 7, and SAGE III. Future versions will improve functionality, increase capacity, and incorporate new technology. The phased incremental releases permit inserting technology proven useful by the prototyping cycle. CH05

Using phased incremental releases requires that even early releases reflect a long range "design to" philosophy and not just a short term "build to" approach. This means that the EOSDIS is designed to accommodate later technology insertion and functional expansion. During implementation of each release the "build to" specification for that release reflects the growth needs of future releases. In this way, additional functionality can be added to, and technology inserted into, the EOSDIS without major rework. EOSDIS must rigorously define an architecture and incorporate technologies that facilitate this process. These technologies include adherence to standards, software isolation of system dependencies, configuration controlled interface points, portability, etc.. Section 5.8 and Appendix A in this document address these needs more specifically. EOSDIS must be built and managed as to effectively adapt to change on an on-going basis, yet achieve the stability required of a system that must manage large volumes of EOS instrument data over the product lifetime. CH05

The operational cycle and prototype cycle support the ESDIS Project's management development approach to prototyping and special studies by 1) anticipating insertion points throughout the life cycle, 2) building the operational system incrementally and thereby delaying technology commitments, 3) providing multiple science software deliverables and a structure that permits rapid investigation and confirmation of user requirements, 4) responding to user sensitive areas with specific prototypes that allow the users to articulate their needs tangibly, and 5) evaluating promising technology in an adaptable prototype environment.

The phased series of incremental releases will be defined by the Earth Sciences Data and Information System Project, with consultation from the DAACs, the Affiliated Data Centers, the EOSDIS Science Advisory Panel, and representatives from the GCDIS community.

Figure 4-2 presents the final architecture of the EOS ground system.

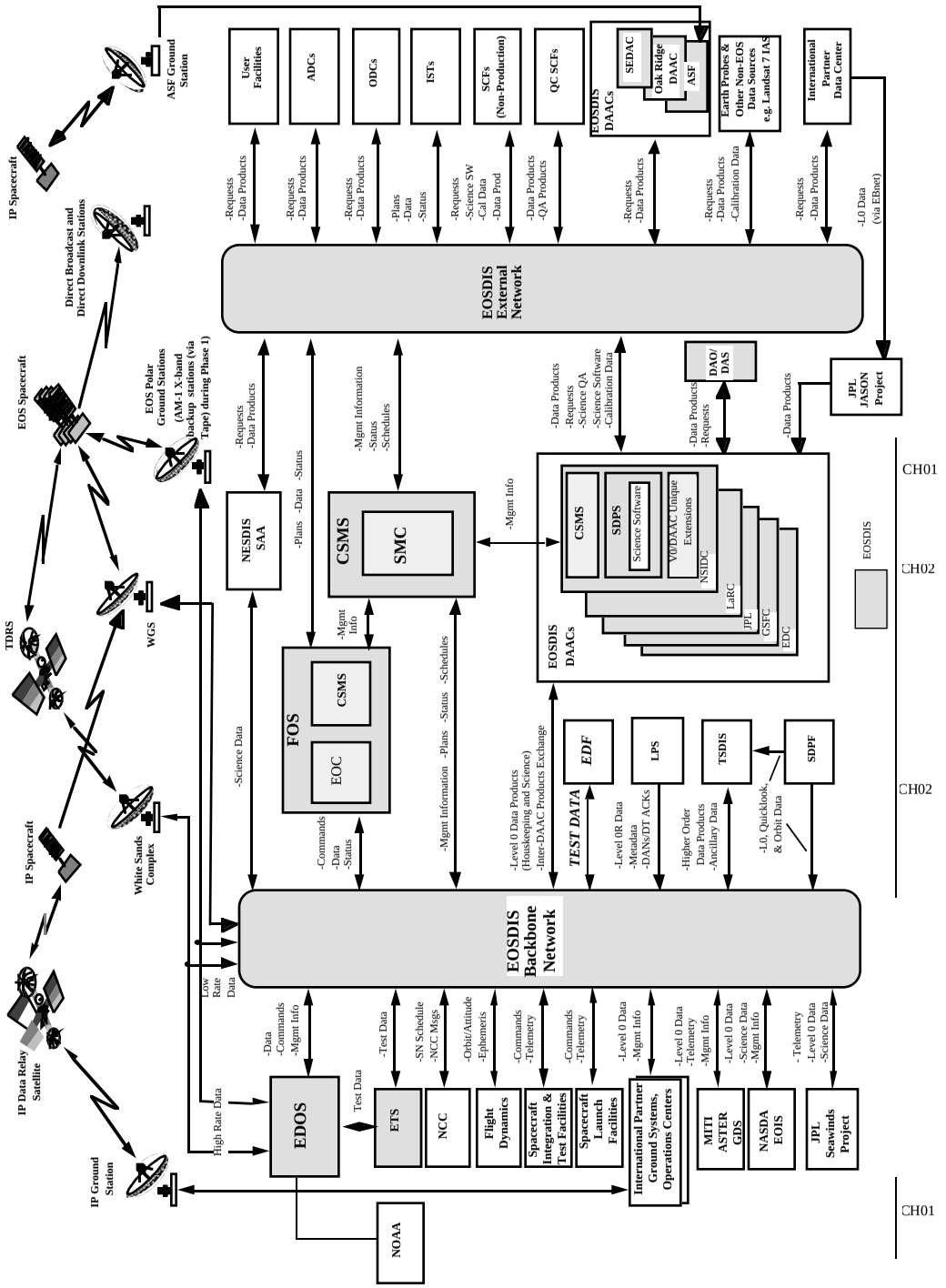

Figure 4-2. EOS Ground System Final Architecture

Section 5. Requirements

5.1 EOSDIS Data Handling Requirements

EOSDIS will support existing data holdings resident at the DAACs, will include Pathfinder data, will support field campaigns, and will ingest selected earth science data sets previously archived by the NASA Space Science Data Center (NSSDC). Figure 5-1 represents the baseline of currently identified future spacecraft and instruments included in Mission to Planet Earth that will be supported by EOSDIS. Figure 5-1 also shows which major version of EOSDIS (e.g., Version 0 or Version 1) will have primary responsibility for data from the spacecraft and instruments. Version 0 of EOSDIS was developed by the ESDIS Project and the Distributed Active Archive Centers (DAACs) and has been operational since August 1994. Version 1 is currently being developed by the DAACs responsible for supporting the TRMM mission, and by EOS investigators selected to develop science production software. Subsequent versions of EOSDIS may also be extended by DAAC development efforts. All data first made accessible via Version 0 will later be accessible via the ECS-delivered system, beginning with Version 1. CH05

This figure also summarizes the type of support (e.g., Production, Archive, Distribution) that will be provided to each mission by the data center(s) supporting that mission. Multiple launches for a given series (e.g., EOS-AM) are represented by a collinear timeline, numbered to show each launch. CH05

The Earth science data managed by EOSDIS is physically resident at the Distributed Active Archive Centers (DAACs). Each of these DAACs holds, manages, and distributes Earth science data from a particular discipline or set of disciplines. A comprehensive list of the data held and planned to be acquired by each of the DAACs is contained in Reference [2]. EOSDIS also includes a data center at the Consortium for International Earth Science Information Network (CIESIN), which addresses socioeconomic and related human dimensions applications. One of the functions of CIESIN is to develop and operate a Socioeconomic Data and Applications Center (SEDAC). The disciplines for which the DAACs and the SEDAC hold data are listed below in Table 5-1. Table 5-1 lists systems in which initial data sets were made available. These data sets will initially be made accessible via EOSDIS Version 0 and later be fully accessible via subsequent EOSDIS versions. Future missions supported by each DAAC are also listed.

The EOSDIS element support is further delineated in Appendix D (Mission Specific Requirements).

This table will show data rates, destinations and services that place requirements on EDOS processing, EBnet communications and ground system antennas.

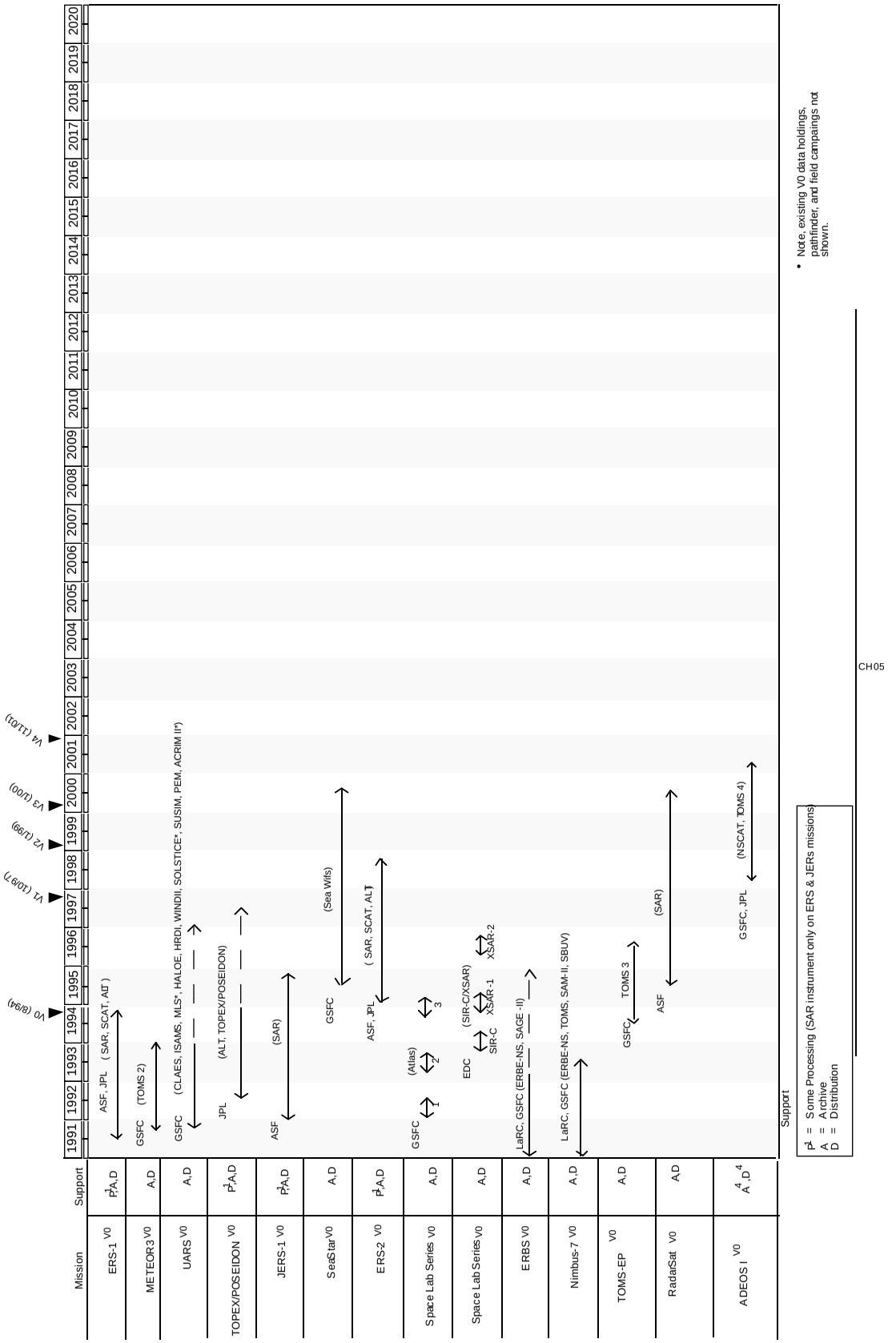

Figure 5-1. EOSDIS Mission Profile (page 1 of 2)

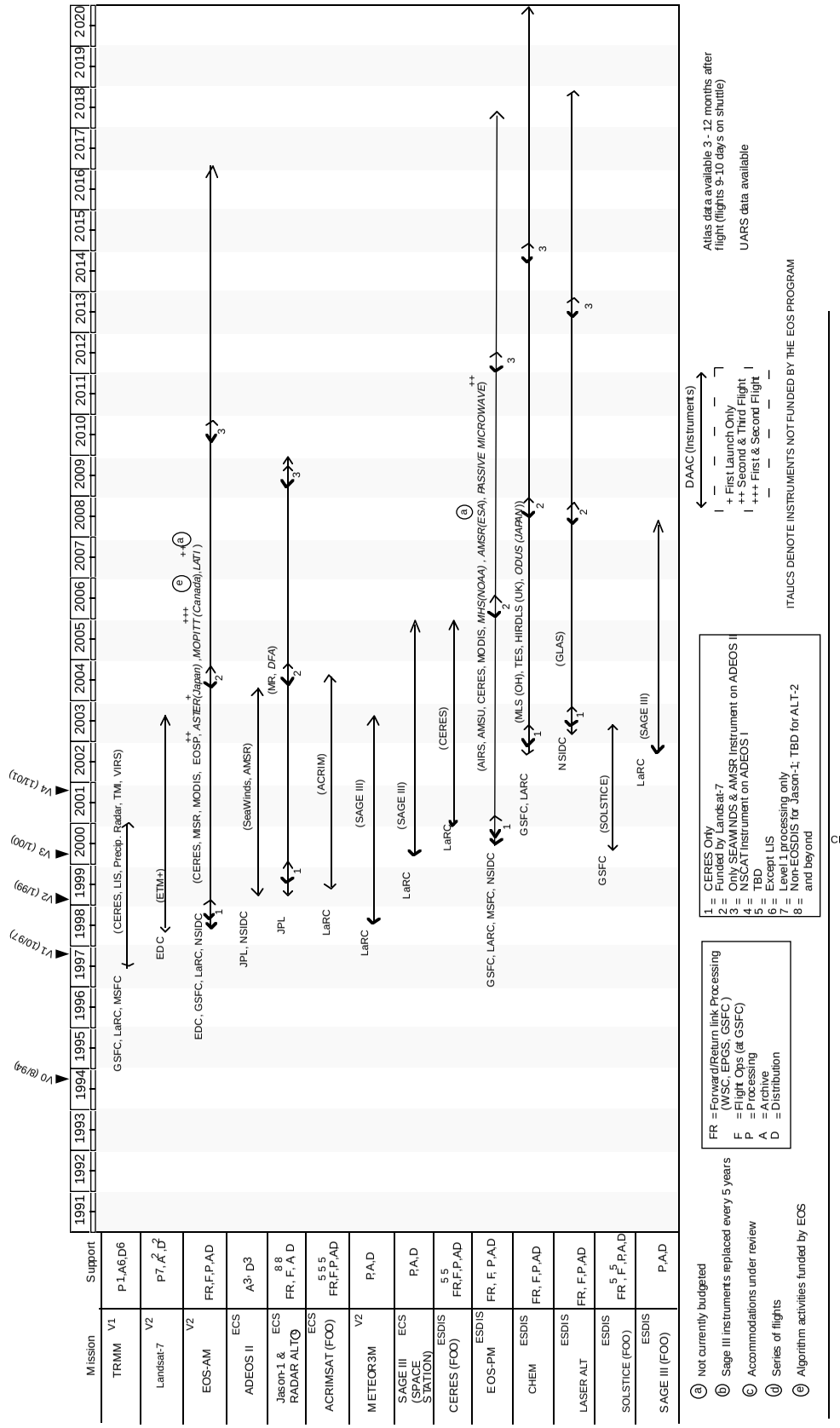

Figure 5-1. EOSDIS Mission Profile (page 2 of 2)

Table 5.1. EOSDIS-Sponsored Data Centers

Initial Data Center	System	Discipline(s)	Key Instruments	
ASF - (Alaska SAR Facility) DAAC	ASF System	Sea ice, polar processes from synthetic aperture radars	SAR - ERS-1, JERS-1, ERS-2, Radarsat, and ongoing role as ground station	
EDC - (EROS Data Center) DAAC	GLIS, Landsat Processing	Land process imagery	ASTER, MODIS (Level 2 and above land), SAR (land), AVHRR (1km), SIRC/XSAR,Landsat ETM+, AMSR-E (land)	CH06
GSFC - (Goddard Space Flight Center) DAAC	NCDS, PLDS, CDDIS	Upper atmosphere, atmospheric dynamics, global biosphere, geophysics	MODIS, AIRS, HSB, AMSU, AMSR-E, (atmospheric dynamics), SeaWiFS (I+II), GLAS, HIRDLS, TOMS, VIRS, Atlas, SOLSTICE (I+II), MLS, AVHRR Pathfinder (land, atmos.), TOVS Pathfinder, UARS (all), TMI and TRMM PR.	CH06
JPL - (Jet Propulsion Laboratory) DAAC	NODS	Ocean circulation and air-sea interaction	TOPEX/Poseidon, NSCAT, AVHRR Pathfinder (SST), SeaWinds data, AMSR (ADEOS II) brightness temp & aux data, ADEOS II ancillary data, AMSR-E (oceanographic), MR, and DFA	CH06
LaRC - (Langley Research Center) DAAC	ERBE Processing	Radiation budget, aerosols, tropospheric chemistry	CERES, ERBE, ACRIM, MOPITT, MISR, EOSP, SAGE (I+II), and TES	
NSIDC-(National Snow and Ice Data Center) DAAC	CDMS	Cryosphere	MODIS (snow & ice), SMMR, SSM/I, OLS, GLAS, AMSR-E (snow and ice) and AMSR (Level 1b)	CH06
ORNL - (Oak Ridge National Laboratory) DAAC	TGDDIS	Biogeochemical dynamics	Ground-based data relating to biogeochemical dynamics	
CIESIN-(Consortium for International Earth Science Information Network) DAAC	--------	*Human dimensions of global change and policy making applications*	*Socioeconomic data*	CH06

The following requirements identify the functionality that will be provided by the EOSDIS in support of missions included in the Mission to Planet Earth initiative. The information is presented graphically in Figure 5-1. Detailed information (e.g. instrument data rates, spacecraft launch dates, etc.) for each flight may be found in Reference [6]. Each requirement is associated with a unique identifier, which appears at the right side of the page.

5.1.1 Mission Support

5.1.1.1.	Version 0 shall generate selected products from SAR instrument, and archive and distribute standard products from the SAR, SCAT, and ALT instruments on-board the ERS-1 spacecraft.	203250
5.1.1.2.	Version 0 shall archive and distribute standard products from the TOMS 2 instrument on-board the METEOR3 spacecraft.	203251
5.1.1.3.	Version 0 shall archive and distribute standard products from the CLAES, ISAMS, MLS, HALOE, HRDI, WINDII, SOLSTICE, SUSIM, PEM, and ACRIM II instruments on-board the UARS spacecraft.	203252
5.1.1.4.	Version 0 shall generate selected products and archive and distribute standard products from the ALT, TOPEX/POSEIDON instruments on-board the TOPEX/POSEIDON spacecraft.	203253
5.1.1.5.	Version 0 shall generate, archive and distribute standard products from the SAR instrument on-board the JERS-1 spacecraft.	203254
5.1.1.6.	Version 0 shall archive and distribute standard products from the SeaWifs instrument on-board the SeaStar spacecraft.	203255
5.1.1.7.	Version 0 shall generate selected products from the SAR instrument, and archive and distribute standard products from the SAR, SCAT and ALT instruments on-board the ERS-2 spacecraft.	203256
5.1.1.8.	Version 0 shall archive and distribute standard products from Atlas instruments on-board the Shuttle Spacelab series of missions.	203257
5.1.1.9.	Version 0 shall archive and distribute standard products from the SIR-C/XSAR instruments on-board the Shuttle Spacelab series of missions.	203258
5.1.1.10.	Version 0 shall archive and distribute standard products from the ERB-NS and SAGE-II instruments on-board the ERBS spacecraft.	203259
5.1.1.11.	Version 0 shall archive and distribute standard products from the ERB-NS, TOMS, SAM-II, and SBUV instruments on-board the Nimbus-7 spacecraft.	203260
5.1.1.12.	Version 0 shall archive and distribute standard products from the TOMS-3 instrument on-board the TOMS-EP spacecraft.	203261

5.1.1.13.	Version 0 shall archive and distribute standard products from the following Pathfinder efforts: SSM/I, TOVS, AVHRR, Landsat, and GOES.	203262	
5.1.1.14.	Version 0 shall generate selected products from the SAR instrument, and archive and distribute standard products from the SAR instrument on-board the RadarSat spacecraft.	203263	
5.1.1.15.	Version 0 shall archive and distribute standard products from the NSCAT and TOMS-4 instruments on-board the ADEOS I spacecraft.	203264	
5.1.1.16.	The EOSDIS shall generate standard products from the CERES instrument, and archive and distribute standard products from the CERES, PrecipRadar, TMI and VIRS instruments on-board the TRMM spacecraft.	203265	CH05
5.1.1.17.	The ECS shall archive and distribute standard products from the ETM+ instrument on-board the LANDSAT 7 spacecraft.	203266	
5.1.1.18.	The ESDIS shall provide flight operations support, and generate, archive and distribute standard products from the CERES, MODIS, MISR, ASTER, MOPITT, EOSP and LATI instruments on-board the EOS-AM series of spacecraft.	203267	
5.1.1.19.	The ECS shall generate, archive and distribute standard products from the SeaWiFS-II instrument as part of a COLOR data purchase.	203268	
5.1.1.20.	The ECS shall archive and distribute standard products from the SAGE III instrument on-board the Russian's Space Agency's METEOR 3M-1 spacecraft.	203269	CH07
5.1.1.21.	The ESDIS shall provide flight operations support, and generate, archive and distribute standard products from the CERES, MODIS, AIRS, AMSU, HSB, and AMSR-E instruments on-board the EOS-PM series of spacecraft.	203270	CH06
5.1.1.22.	The ECS shall archive and distribute standard products from the MR and DFA instruments on-board the JASON-1 and RADAR ALT spacecrafts.	203271	CH02
5.1.1.23.	The ESDIS shall provide flight operations support, and generate, archive and distribute standard products from the HIRDLS, ODUS, MLS, and TES instruments on-board the EOS-CHEM series of spacecraft.	203272	
5.1.1.24.	The ESDIS shall provide forward and return link services, capture, Level Zero Process, and distribute data from the CERES, MODIS, MISR, ASTER, MOPITT, EOSP and LATI instruments on-board the EOS-AM series of spacecraft.	203273	CH06
5.1.1.25.	The ESDIS shall provide forward and return link services, capture, Level Zero Process, and distribute data from the CERES, MODIS, AIRS, AMSU, HSB, and AMSR-E instruments on-board the EOS-PM series of spacecraft.	203275	CH06

5.1.1.26.	The ESDIS shall provide forward and return link services, capture, Level Zero Process, and distribute data from the HIRDLS, ODUS, MLS, and TES instruments on-board the EOS-CHEM series of spacecraft.	203277	
5.1.1.27.	The ECS shall provide data archives, and distribution of SeaWinds AMSR (Level 1b only) standard data products. (ADEOS II mission).	203397	CH02
5.1.1.28.	The ESDIS shall provide forward and return link services, capture, Level Zero Process, and distribute data from the GLAS instrument on-board the LASER ALT series of spacecraft.	203384	
5.1.1.29.	The ESDIS shall provide flight operations support, and generate, archive and distribute standard products from the GLAS instrument on-board the LASER ALT series of spacecraft.	203385	
5.1.1.30.	The ECS shall archive and distribute standard products from the SAGE III instrument on-board the SAGE III spacecraft (Space Station).	203386	CH07
5.1.1.31.	The ECS shall generate, archive and distribute standard products from the ACRIM instrument on board the ACRIMSAT spacecraft (Flight of Opportunity).	203387	
5.1.1.32.	The ECS shall generate, archive and distribute standard products from the CERES instrument on-board the CERES spacecraft (Flight of Opportunity).	203388	
5.1.1.33.	The ESDIS shall generate, archive and distribute standard products from the SOLSTICE instrument on-board the SOLSTICE spacecraft (Flight of Opportunity).	203389	
5.1.1.34.	The ESDIS shall archive and distribute standard products from the SAGE III instrument on-board the SAGE III spacecraft (Flight of Opportunity).	203390	CH07
5.1.1.35.	Version 0 shall archive and distribute data from the LIS precursor mission (Optical Transient Detector (OTD) April 95 (2 year + mission)).	203391	

5.1.2 Existing Data

5.1.2.1.	Version 0 shall make accessible, via an Earth sciences view, Earth sciences data held by initial existing systems at the DAACs as per Reference [2].	203278
5.1.2.2.	Version 0 shall make accessible, via an Earth sciences view, Earth sciences data held by NSSDC.	203279

5.1.2.3.	Version 0 shall upgrade the levels of service provided for existing data holdings following priorities assigned by the scientific community as per Reference [2].	203280

5.1.3 Non-Spacecraft Data

5.1.3.1.	Version 0 shall archive and distribute collected field data measurements and archive and distribute standard products from the BOREAS, FIFE, OTTER, Global Tropospheric Experiment, FIRE, TOGA-COARE, GEDEX, ISCCP, and FIFE-follow-on field experiments.	203281

5.2 Overall System Requirements

EOSDIS is the information system infrastructure needed to support the collection, processing, archival, distribution, and analysis of the science data, and the operation of the space and ground based EOS systems.

5.2.1.	The EOSDIS shall serve as NASA's Earth science discipline data system for information management, archival, and distribution of NASA Earth science data, as specified in Section 5.1.	203282
5.2.2.	The EOSDIS shall operate according to the ESDIS Project Program Data Management Plan (PDMP), Reference [5].	203283
5.2.3.	The EOSDIS shall maintain processing, archiving, and distribution functions of EOS standard products until 3 years beyond the end of the last EOS flight operations.	203284
5.2.4.	The EOSDIS shall archive all research products provided to EOSDIS by Users for research use and accepted for EOSDIS archive and distribution by the IWG.	203285
5.2.5.	The EOSDIS shall provide the capability to quality assure (QA) EOS Standard Data Products by the responsible investigator(s) within the time period allowed for the product generation.	203286
5.2.6.	The EOSDIS shall maintain, in a separate location, a secure backup archive of all Level 0 data or higher level data from which Level 0 can be recovered.	203287
5.2.7.	The data and metadata of V0 shall be made accessible by subsequent versions of the ECS with equivalent or better levels of service.	203288
5.2.8.	EOSDIS shall provide, where practical, access to all available non-EOS data generated or stored by external data systems that are required to perform data set production and validation tasks.	203289

5.2.9.	The EOSDIS shall archive all standard data products, models, algorithms, source code, and documentation produced as part of the EOS mission.	203290	
5.2.10.	The EOSDIS shall support ingest of digital data from external sources including non-EOS data archives, International Partners, and investigators as required to support data product generation and quality assessment.	201427	
5.2.11.	The EOSDIS shall support distribution of standard science data algorithms, and special product algorithms that are submitted to EOSDIS.	203291	
5.2.12.	The EOSDIS shall use the SN for AM-1 primary forward and return link communications until primary communications transition to the EOS Polar Ground Stations.	203396	CH03
5.2.13.	The EOSDIS shall use ground stations at Alaska, Norway, and the Wallops Orbital Tracking Station (WOTS), for backup/contingency forward and return link communications during the period when the SN is performing primary communications.	203392	CH01 CH03
5.2.14.	The EOSDIS shall use the EOS Polar Ground Stations for primary forward and return link communications for EOS spacecraft following the transition of primary communications from the SN. During this period, the EOSDIS shall continue to use the SN for space/ground communications, tracking and spacecraft clock correlation for EOS-AM1 as needed.	203393	CH03 CH03
5.2.15.	The EOSDIS shall use the WOTS and the SN for backup/contingency forward and return link communications during the period when the EOS Polar Ground Stations are performing primary communications.	203394	CH01, 03 CH03
5.2.16.	The EOSDIS shall comply with the ESDIS Security Plan.	203395	

5.3 Networking And Communication Requirements

5.3.1 Overall Networking and Communications Requirements

5.3.1.1.	(Deleted)	203292	CH03
5.3.1.1.1	The EOSDIS "Mission Critical" class of network services shall provide data transmission for platform and instrument command and control, and for transmission of engineering and science data to the ECS.	203293	

5.3.1.1.2.	The EOSDIS "Mission Essential" class of network services shall provide data transmission between the ECS DAACs, in support of production processing and other functions, and between DAACs and other systems (such as ADCs) which provide data for EOS data production.	203294	
5.3.1.1.3.	The EOSDIS "Mission Success" class of network services shall provide access to EOS data products and services to science investigators and other users.	203295	
5.3.1.2.	All EOSDIS networks shall provide performance, availability, and security consistent with the functions provided.	203296	
5.3.1.3.	All EOSDIS networks shall incorporate network management capability, which shall include: - Configuration Management, - Testing and Validation, - Fault Detection, - Fault Isolation, - Fault Recovery, - Data Collection, - Data Analysis, - Data Reporting	203297	
5.3.1.4.	All EOSDIS Networks shall accommodate usage growth over the life of EOSDIS, with minimal disruptions.	203298	

5.3.2 Mission Critical Networking and Communications Requirements

5.3.2.1.	The EOSDIS Mission Critical network services shall support the transmission of spacecraft command, telemetry, and orbit data, including engineering and science data.	203300	
5.3.2.2.	The EOSDIS Mission Critical network services shall connect the EOS Operations Center, EDOS, DAACs (delivery of Level 0 data), the White Sands Complex, EOS Polar Ground Stations and the Integration Facility.	203301	CH03
5.3.2.3.	The EOSDIS Mission Critical network services shall provide communications between ECS and International Partners facilities, in support of joint instruments/spacecraft, according to appropriate Memoranda of Understandings.	203302	
5.3.2.4.	The EOSDIS Mission Critical network services shall interface to the Space Network and the EOS Polar Ground Stations for both forward link and return link communications.	203303	CH03

5.3.3 Mission Essential Networking and Communications Requirements

5.3.3.1. The EOSDIS Mission Essential network services shall provide communications between the DAACs, and between the DAACs and selected ADCs and IPs. 203304

5.3.3.2. The EOSDIS Mission Essential network services shall provide the following capabilities: 203305

- File Transfer,
- Process to Process Communications,
- Network Management,
- Network Access and Security

5.3.4 Mission Success Networking and Communications Requirements

5.3.4.1. The EOSDIS Mission Success network services shall provide access to the DAACs and EOSDIS data to scientific investigators and other users. 203306

5.3.4.2. The EOSDIS Mission Success network services shall provide the following capabilities: 203307

- File Transfer,
- Process to Process Communications,
- Remote Login,
- Electronic Mail,
- Network Management,
- Network Access and Security

5.3.4.3. The NASA Science Internet shall be responsible for the overall EOSDIS Mission Success services, engineering, and management. 203308

5.3.4.4. The Mission Success network services shall provide for access via commercial, institutional, and educational networks, including NSFNet, NREN, and BITNET. 203309

5.3.4.5. The Mission Success network services shall provide for international access as specified in the appropriate MOUs. 203310

5.4 SYSTEM OPERATIONS REQUIREMENTS

System operations of EOSDIS include all ground resource operations relating to the science data products, information management and the interactions of the users with these data. System operations requirements in this section apply to all elements managed or funded by ESDISP, except for Version 0.

5.4.1.	System operations shall include services and management functions for the following: configuration, performance, fault, security, accounting, accountability and directory.	203311
5.4.2.	System operations shall perform coordination functions amongst EOSDIS elements including coordination of science data processing functions (e.g., schedule monitoring and exception resolution) and operational ground events (e.g., maintenance, testing, upgrades).	203312
5.4.3.	System operations shall perform coordination functions between EOSDIS elements and supporting EOS Ground System elements and users including coordination of scheduling, security, faults and operational activities (e.g., maintenance, testing, upgrades).	203313
5.4.4.	System operations shall perform coordination functions between the Program, IWG, ESDIS project and EOSDIS including coordination for the dissemination, execution and feedback involving policy, schedules, priorities, planning, performance, and administrative matters.	203314
5.4.5.	EOSDIS shall perform its operations in accordance with applicable NASA and other U.S. Government agency applicable policies and procedures.	203315
5.4.6.	EOSDIS elements shall support end-to-end EOS Ground System testing.	203316
5.4.7.	System operations functions shall support end-to-end EOS Ground System testing.	203317
5.4.8.	System operations functions shall support Independent Verification and Validation.	203318

5.5 Mission Operations Requirements

Mission operations include the operation of all EOSDIS elements and institutional facilities required for the effective command and control of each EOS spacecraft and for the successful acquisition of science data. Mission operations apply to the pre-launch and on-orbit phases, including integration and testing, end-to-end testing and simulations, launch, early orbit checkout, normal operations, cross-over operations, through spacecraft end-of-life activities.

5.5.1.	Mission operations shall include services and management functions for the following: ground system configuration, schedule coordination, spacecraft resources usage and conflict resolution, monitoring and management of spacecraft systems, basic health and safety monitoring of the instruments, and ground operations resource utilization (e.g., spacecraft simulator).	203319

5.5.2.	Mission operations shall perform coordination functions among EOSDIS elements, with instrument operations teams, with the EOS Project Scientists, with NASA institutional facilities, and, with the EOS Flight Projects, for single/multiple spacecraft real time operations, including planning and scheduling of spacecraft and instrument activities, commanding, health and safety monitoring, and engineering and science data retrieval.	203320
5.5.3.	Mission operations shall provide fully redundant capabilities for the command and control of a single or multiple EOS spacecraft, including the health and safety monitoring of the spacecraft and the instruments, and the capture and quality check of all return link EOS data, including real time engineering data, playback engineering data and spacecraft memory dump data.	203321
5.5.4.	Mission operations shall provide capabilities to support replacement spacecraft operations testing, ground system testing, simulations, and training, without disruption to other ongoing multiple EOS spacecraft real time operations.	203322
5.5.5.	Mission operations shall perform coordinated functions with all applicable NASA institutional elements required for real time operations of a single or multiple EOS spacecraft, including resource utilization (e.g., SN, WOTS).	203323 CH01, 05
5.5.6.	Mission operations shall support coordination functions among EOSDIS elements and the NASA institutional elements to support single or multiple EOS spacecraft anomaly investigation and resolution.	203324
5.5.7.	Mission operations shall be performed in accordance with applicable NASA and other U.S. Government agency policies and procedures to ensure spacecraft safety and security, and compatibility with U.S. and appropriate international standards for communications and interface interoperability.	203325
5.5.8.	Mission operations functions shall support end-to-end EOS Ground System testing.	203326
5.5.9.	Mission operations shall support independent verification and validation.	203327

5.6 ESDIS Project-Wide Requirements

5.6.1.	The ESDIS Project shall provide physical access control to EOSDIS facilities.	201255
5.6.2.	The ESDIS Project shall support the design, development, and operations of EOSDIS capabilities that interface to science users and the resolution of inter-site science concerns.	201421
5.6.3.	The ESDIS Project shall provide for assistance in responding to user questions relating to EOSDIS functionality and joint science/programmatic concerns and issues.	201422

5.6.4.	The ESDIS Project shall provide a baseline set of software services to perform general purpose science data processing in support of data product generation and quality assessment.	201424
5.6.5.	The ESDIS Project shall support the development and application of science data standards.	201425
5.6.6.	The ESDIS Project shall support the integration of new or updated data products and algorithms within EOSDIS.	201426
5.6.7.	The ESDIS Project shall provide for the supplying of EOS product generation software to science users where the use of proprietary software within the product generation software does not severely inhibit modification of the science algorithm.	201467
5.6.8.	The ESDIS Project shall ensure active, continuous, iterative participation by users, including the EAP-EOSDIS science advisory panel, the DAAC science advisory groups, and the user community in evaluation of EOSDIS functionality, and performance.	201469
5.6.9.	The ESDIS Project shall permit inclusion of new or modified requirements during the life of the mission with appropriate established change control procedures.	201470
5.6.10.	The EOSDIS functional requirements shall be implemented in priority order where the priorities are recommended by the science community and approved by the ESDIS Project.	201471
5.6.11.	The ESDIS Project shall maintain an up-to-date assessment of system use, product use, and user satisfaction.	201472
5.6.12.	The ESDIS Project shall provide for annual peer review assessment of product use, system use, and user satisfaction. This assessment includes independently characterizing the performance of current EOS products and systems in meeting scientific requirements. The assessment shall generate recommendations for retention, removal or modification of existing EOS products and interfaces, and recommendation of new products or interfaces.	201473
5.6.13.	The ESDIS Project shall provide a capability for trade-off studies, special studies, prototyping activities, and resolution of key technical issues throughout the life of the Project.	201474
5.6.14.	The ESDIS Project shall negotiate with NASA non-EOS Earth Science Flight Projects ground systems, International Partners and Investigators to arrange for EOSDIS ingest (data and metadata translation as negotiated) of their non-EOS data and information as required to support production of EOS standard products.	201478
5.6.15.	The ESDIS Project shall provide a Science Computing Facility to each U.S. EOS science investigation managed by the ESDIS Project.	203328
5.6.16.	The ESDIS Project shall support the development of discipline-unique services by DAACs.	203329

5.6.17.	The ESDIS Project shall continuously incorporate into EOSDIS the results of the user experience and prototyping.	201575

5.7 IV&V

5.7.1.	The ESDIS IV&V activity shall maximize its use of the NASA Facility at Fairmont, West Virginia.	203330
5.7.2.	The ESDIS IV&V activity shall verify and validate that the EOSDIS system meets the the EOSDIS requirements.	203331
5.7.3.	The ESDIS IV&V activity shall conduct validation and verification activities throughout the EOSDIS life cycle.	203332
5.7.4.	The ESDIS IV&V activity shall conduct validation and verification activities tailored to the EOSDIS evolutionary development life cycles.	203333
5.7.5.	The ESDIS IV&V activity shall conduct validation and verification activities tailored to the needs of the EOSDIS hardware and software architecture to accommodate changing requirements and changing technologies.	203334
5.7.6.	The ESDIS IV&V activity shall conduct validation and verification activities permitting measurement of science user satisfaction.	203335

5.8 Overall System Architecture Requirements

EOSDIS shall be developed following architectural practices as required to sustain an evolving data and information system, serving users beginning with the delivery of the Version 0 and with a long term (at least 18 years past the launch of AM1) operational life. EOSDIS must also support and enable growth and evolution of GCDIS. To these ends, EOSDIS software components must be shareable with other GCDIS agencies and be extensible by parties other than solely the ESDIS Project. As such, the EOSDIS architecture must be designed following the design criteria and principles as outlined in Appendix A. Further, the requirements in this section outline the extensions to the EOSDIS anticipated by other parties and agencies.

5.8.1 V0 Overall Architecture Requirements

V0 shall be developed to facilitate migration from V0 to V1. Interfaces between Version 0 and Version 1 must accommodate migration of data and metadata. This includes, but is not limited to:

5.8.1.1.	Version 0 shall, where practical, store and distribute new data in HDF format in accordance with priorities and levels of services identified in Reference [2].	203336
5.8.1.2.	Version 0 shall describe new data in catalog systems (i.e., directory, guide, granule inventories, etc.) following ESDIS Project PDMP	203337

(Reference [5]) guidelines.

5.8.1.3.	Version 0 shall develop browse products for new data in accordance with priorities and levels of services identified in Reference [2].	203338
5.8.1.4.	Version 0 shall archive new data on archival quality media in accordance with priorities and levels of services identified in Reference [2].	203339
5.8.1.5.	Version 0 shall upgrade old data, where practical and as prioritized by the scientific community as per Reference [2], to be stored and distributed in HDF.	203340
5.8.1.6.	Version 0 shall upgrade old data, where practical and as prioritized by the scientific community as per Reference [2], to be described in catalog systems following ESDIS Project PDMP guidelines.	203341
5.8.1.7.	Version 0 shall upgrade old data, where practical and as prioritized by the scientific community as per Reference [2], to have browse products.	203342
5.8.1.8.	Version 0 shall upgrade old data, where practical and as prioritized by the scientific community as per Reference [2], to store on media that supports long term archiving.	203343
5.8.1.9.	Version 0 shall provide for search and order among data centers where the data centers have little implementation commonality.	203344
5.8.1.10.	Version 0 shall provide for coordination of management among data centers controlled by independent, autonomous organizations.	203345
5.8.1.11.	Version 0 shall interconnect "loosely coupled" data centers that have no stringent interdependent production, archiving, or distribution performance requirements.	203346
5.8.1.12.	Version 0 shall be developed to facilitate sharing of V0-developed software for search and order among data centers with other GCDIS agencies and science users.	203347
5.8.1.13.	Version 0 shall be developed with configuration-controlled application programmer's interfaces between servers (metadata and browse) resident at the DAACs and user interfaces resident at remote users' workstations.	203348

5.8.2 EOSDIS Overall Architecture Requirements

EOSDIS serves as NASA's Earth science data and information system. In addition, EOSDIS must support the forward and return link services, and flight operations of the series of EOS spacecraft. The following requirements highlight the overall architectural context of EOSDIS, excluding Version 0.

5.8.2.1.	The EOSDIS architecture shall support a series of interdependent	203349

Earth observing spacecraft.

5.8.2.2.	The EOSDIS science data and information system components shall be resident at distributed data centers with implementation commonality only as required to support interdependent production, archiving, and distribution of science data and as required to reduce life cycle cost.	203350
5.8.2.3.	The EOSDIS science data and information system components shall be resident at distributed data centers having implementation differences as required to support the unique user communities and data types supported and managed by that data center.	203352
5.8.2.4.	The EOSDIS science data and information system components shall provide for distributed data centers as "tightly coupled" only as required to support interdependent production, archiving, or distribution performance requirements as specified in Volume 1 of these Level 2 requirements, and as demonstrated to be insupportable by distributed systems technology.	203353
5.8.2.5.	The EOSDIS shall provide for support of coordinated management of distributed data centers.	203354
5.8.2.6.	The EOSDIS shall provide for support of coordinated management of multiple spacecraft.	203355
5.8.2.7.	The EOSDIS Core System shall be developed such that EOSDIS may evolve to be an apparent federated unit within GCDIS, where EOSDIS, as a whole, shall be "loosely coupled" to other GCDIS agency systems (e.g., a GCDIS data center should not be required to negotiate different interfaces with each DAAC).	203356
5.8.2.8.	The EOSDIS data capture, level 0 processing, and flight operations system shall be developed so as to provide a "core" system composed of modular components that may be extended by the addition of other components or evolved by the replacement of components.	203357
5.8.2.9.	The EOSDIS data capture, level 0 processing, and flight operations core system components shall be developed for an architectural environment where spacecraft or instruments may be added or deleted without major rework of the core components.	203358
5.8.2.10.	The EOSDIS science data and information system shall be developed so as to provide a "core" system composed of modular components that may be extended by the addition of other components, or evolved by the replacement of components.	203359
5.8.2.11.	EOSDIS shall, where practical, be developed to facilitate sharing of EOSDIS-developed software with other GCDIS agencies and science users.	203360

5.8.3 DAAC Operational and Development Extensions

The EOSDIS science data and information core system components shall be developed with configuration-controlled applications programming interfaces permitting DAAC extensions, as

specified below. The DAAC interfaces to the core system include, but are not limited to the list below.

Information Management:

5.8.3.1.	The DAACs shall be able to add unique fields to metadata, unique products for browse, unique documents for data products guides, as required for discipline specific user support. These activities shall not require software changes to the core system.	203361
5.8.3.2.	The DAACs shall be able to develop a local user interface that accesses the core metadata and browse data base servers, bypassing the delivered "core" user interface. This server interface shall be configuration controlled and documented for programmers' use.	203362

Data Archiving and Distribution:

5.8.3.3.	The DAACs shall be able to add new storage devices, if required, to serve discipline-unique archiving needs. An applications programming interface that permits the DAACs to integrate this addition to the DAAC shall be developed and configuration controlled.	203363
5.8.3.4.	The DAACs shall be able to add new data types similar to previous types with minimal changes to software of the core system.	203364
5.8.3.5.	The DAACs shall be able to add new data types significantly different from previous types without significant changes to the core architecture.	203365

Product Generation:

5.8.3.6.	The DAACs shall be able to use the data production environment tool kit to develop and integrate new algorithms developed at the DAACs to support DAAC value-added production.	203366
5.8.3.7.	The DAACs shall be able to add to a data production environment tool kit DAAC-developed software required to support discipline specific needs.	203367

Operations:

5.8.3.8.	The DAACs shall be able to use local core system management functions to access and view the EOSDIS-wide system management functions in support of local DAAC scheduling.	203368

Other DAAC-Unique Extensions to the Core System:

5.8.3.9.	The DAACs shall have access to configuration controlled applications programming interfaces that permit them to develop DAAC-unique value added services and products where DAAC-unique value added services may consist of one or more of the following types of developments: - Visualization Utilities and Products, - Datasets and inter-dataset usability Utilities and Products, - Data Analysis Utilities, - Special Subsetting Capabilities (e.g., dynamic), - On-line Analysis Functions, - New Search Techniques, - Data Acquisition Planning and Utilities, - Experimental QA Techniques, - Non-digital Data Utilities and Products	203369
5.8.3.10.	DAAC-unique value added services require applications programming interfaces accessing the production engine, the data file servers, the metadata and browse data base servers and access to local and remote system management services.	203370

5.8.4 Use of EOSDIS Components Non-EOSDIS Data Centers

The EOSDIS science data and information core system architecture must not preclude the separate installation of information management, data production, or data and distribution software components into a non-EOSDIS data center. The non-EOSDIS data centers will have full responsibility for integration of those components within their environment. These interfaces must be developed to serve the mission of EOSDIS, but be made available for a non-EOSDIS data center. This requires:

5.8.4.1.	The EOSDIS core system architecture shall support configuration controlled and documented application programmers interfaces between logical information management and physical data archiving components.	203371
5.8.4.2.	The EOSDIS core system architecture shall support configuration controlled and documented application programmers interfaces between data production and logical information management components.	203372
5.8.4.3.	The EOSDIS core system architecture shall support configuration controlled and documented application programmers interfaces between physical data archiving and data production components.	203373
5.8.4.4.	The EOSDIS core system architecture shall support configuration controlled and documented applications programmers interfaces	203374

between user interfaces and metadata and browse data base servers.

5.8.4.5.	The EOSDIS core system architecture shall support configuration controlled and documented applications programmers interfaces between science algorithms and data production resources.	203375
5.8.4.6.	The EOSDIS core system architecture shall support configuration controlled and documented applications programmers interfaces between archive management operations interfaces and archive file servers.	203376

5.8.5 Science Users Development Extensions

The EOSDIS shall be developed with configuration-controlled software interfaces permitting science user extensions to the core, as specified below:

5.8.5.1.	The EOSDIS core system shall support science user development of new search and access techniques that dynamically browse the data and metadata. These techniques shall be developed at the scientist's facility, supported by EOSDIS developed toolkits.	203377
5.8.5.2.	The EOSDIS core system shall be able to insert and/or add new search and access techniques developed by science users.	203378
5.8.5.3.	The EOSDIS core system shall permit general science user access to science user developed search and access techniques, but shall limit system resource usage to ensure no interference with routine production, data distribution, or search and access functions.	203379
5.8.5.4.	The EOSDIS core system shall be capable of incremental growth in capacity and performance for the science user developed search and access techniques, where growth is independent of the routine production, data distribution, and search and access functions.	203380
5.8.5.5.	The EOSDIS core system shall be able to export all or major subsets of the metadata to science users using science user developed search and access techniques at their remote facilities.	203382
5.8.5.6.	EOS product generation software shall avoid the use of proprietary software where the use of proprietary software may severely inhibit modification of the science algorithm by other science users.	203383

Appendix A - EOSDIS Design Criteria And Principles

This appendix contains statements of criteria to be used to determine if EOSDIS has the aspects of a "good design". The design of EOSDIS must include a reference architecture adhering to the following principles. These design criteria of EOSDIS must hold true from initial design concepts to implementation in the "as built" EOSDIS system and must be rigorously maintained throughout the maintenance and operations phases of the system. A design or redesign review of any component of EOSDIS must consist of how that component satisfies these criteria.

Version 0 is exempted from these design criteria, except as applied to new software components being developed. Version 0 integrates heritage code within existing systems. It is not the intent to rewrite existing code following these criteria.

The EOSDIS must be developed with an open systems architecture. This requires that the system should:

- be highly portable,
- avoid dependence on any particular vendor computer hardware system, database management system, or networking capability,
- isolate and document any unavoidable dependencies on specific vendor hardware with the approach taken to be approved by the ESDIS Project
- where practical, be capable interoperating with external systems following generally accepted community or open systems standards

The architecture and design must be evolvable/open to changes in user requirements, programmatic mission requirements, and availability of new technology. This requires that the system should:

- be insensitive to lower level requirements changes, e.g. the addition of a new data set shall not require rewriting software,
- isolate logical design from physical design to allow change out of physical elements without requiring changes to application software or higher level systems software, e.g. isolating the logical inventory from the physical media inventory,
- isolate [by layering] and modularize areas with high likelihood to change,
  - poorly understood/incomplete/new requirements (e.g., user access patterns, programmatic additions of flights, etc.)
  - new technology (e.g., networking technology)
  - high user interaction (e.g., data search and order)
  - external access (e.g. other data centers, NASA institutional systems, etc.)

- maximize use of standards (at all interfaces, for software environment, data and metadata, etc.) with a particular emphasis on those interfaces to areas with a high likelihood of change (as above),
- where practical, and where promising community standards are not adequately mature for use, build with compatible conceptual designs that will permit later insertion of mature standards,
- maximize use of commercially available hardware and software

The architecture and design must be expandable. This requires that the system architecture should:

- include interfaces that will permit easy insertion of additional capabilities as required, (e.g., replacing an RDBMS with an RDBMS with object oriented extensions, adding new data characterization algorithms within the production stream),
- include interfaces that will permit easy insertion of technology supporting increased capacity demands without significant architecture/design change

The architecture and design must be operationally robust. This requires that the system architecture should:

- include standard error handling modules permitting the system to degrade "gracefully" in the presence of failures,
- be functionally redundant where appropriate,
- ensure that functional allocation to architectural elements does not introduce unacceptable delay or the introduction of human error, e.g. introduce a tape transfer mechanism between metadata production and data base population, where the human tape handling results in a delay in product availability,
- support end-to-end system performance analysis

The architecture and design must be sound in principle. This requires that the system architecture should:

- minimize component external interfaces (coupling) and group like functions (cohesion) in order to isolate the effects of modifications to the smallest possible section of code,
- consist of subsystems controlled to similar size and complexity,
- consist of subsystems lending themselves to hierarchical integration testing,
- be structured to support delivery of phases of the system, with highest priority delivered first, lowest priority delivered later as features and options,
- be structured such that significant increases or decreases,or changes in phasing of, capacity can be accommodated without major changes in architecture,
- be structured such that the architecture shall permit cost effective reuse of software,

- minimize life-cycle maintenance costs as long as evolving science requirements are supported,
- facilitate and foster interdisciplinary research,
- follow the principal that standardization, portability, machine independence, ease of evolution should not be sacrificed for optimization, e.g. hardware resources should be sized following this principle

The architecture must facilitate development of external interfaces. This requires that the system architecture should;

- where practical, develop and maintain open interfaces to permit access by remote clients (e.g. other agency systems or user systems) accessing EOSDIS services (see sections 5.3.3, 5.3.4, and 5.3.5 for required interfaces)
- follow science community accepted standards,
- follow or be capable of translating to, international and inter-agency standards,
- where practical, follow or be capable of translating to computer science community de-facto standards,
- implement interfaces that are "simple", for ease of development by external parties on "open" interfaces

The architecture and design must facilitate operability. This requires that the system architecture should:

- where practical, consist of a design where the functional allocation to, and location of, architectural elements is compatible with the human organizational structure, (e.g. data management subsystems are located at DAACs to take advantage of institutional discipline expertise, operations for inter-DAAC product generation must be manageable, analysis subsystems are local to science expertise),
- include standard modules supporting maintenance or fault detection and reporting, soft fail over, etc.,
- support reliability, maintainability and availability commensurate with level of criticality and recoverability

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Appendix B - Glossary

"loosely coupled" - One data center shall have minimal or no knowledge of the other data center's internal architecture, data dictionary, internal data base tables, or internal formats. All multi- data center operations are via negotiated exchanges of standard format messages or standard format data exchanges.

"tightly coupled" - One data center may hold and store knowledge of another data centers internal architecture, data dictionaries, internal data base tables, or internal formats. Multi-data center operations may execute as if one system existed.

shall - need absolute compliance with this requirement

shall, where practical - trade-off analysis required if alternative used

preferred or should- use of alternative must be justified

may - contractor selection acceptable

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Appendix C - Acronyms

ACRIM	Active Cavity Radiometer Irradiance Monitor	
ADC	Affiliated Data Center	
ADEOS	Advanced Earth Observing System	
AGS	Alaska Ground Station	CH01
AIRS	Atmospheric Infrared Sounder	
ALT	Altimeter	
AMSR	Advanced Microwave Scanning Radiometer	
AMSR-E	Advance Microwave Scanning Radiometer - EOS	CH06
ASF	Alaska SAR Facility	
AMSU	Advanced Microwave Sounding Unit	
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer	
ATLAS	Atmospheric Laboratory for Applications and Science	
AVHRR	Advanced Very High-Resolution Radiometer	
BITNET	Because It's Time NETwork	
BOREAS	Boreal Ecosystem-Atmosphere Study	
CCSDS	Consultative Committee on Space Data Systems	
CDDIS	Crustal Dynamics Data Information System	
CDMS	Cryospheric Data Management System (NSIDC)	
CDRC	CIESIN Data and Research Center	
CERES	Clouds and Earth's Radiant Energy System	
CIESIN	Consortium for International Earth Science Information Network	
CLAES	Cryogenic Limb Array Etalon Spectrometer	
CNES	Centre National d'Etudes Spatiales	
COLOR	Ocean Color Flight	
CSA	Canadian Space Agency	
DAAC	Distributed Active Archive Center	
DAO	Data Assimilation Office	CH08
DAS	Data Assimilation System	CH08
DFA	Dual Frequency Altimeter	
DIF	Data Interface Facility	

DMR	Detailed Mission Requirements
DoD	Department of Defense
EAP	EOSDIS Advisory Panel
EBnet	EOS Communications
ECS	EOSDIS Core System
EDC	EROS Data Center
EDOS	EOS Data and Operations System
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
EOSSRP	EOS Scientific Research Program
EOS-AM	EOS Morning Crossing (Descending) Mission
EOS-CHEM	EOS Chemistry Mission
EOS-PM	EOS Afternoon Crossing (Ascending) Mission
EOSSMS	EOS Space Measurement System
EOSP	Earth Observing Scanning Polarimeter
EP	Earth Probe
EPGS	EOS Polar Ground Stations
ERBE	Earth Radiation Budget Experiment
ERBS	Earth Radiation Budget Satellite
EROS	Earth Resources Observation System
ERS	Earth Resources Satellite
ETM+	Enhanced Thematic Mapper Plus
ESA	European Space Agency
ESDIS	Earth Science Data and Information System
ESDISP	Earth Science Data and Information Systems Project
ETS	EOSDIS Test System
FDF	Flight Dynamics Facility
FIFE	First ISLSCP Field Experiement

CH01

CH06

FIRE	First ISCCP Regional Experiment	
FST	Field Support Terminal	
GCDIS	Global Change Data and Information System	
GCRP	Global Change Research Program	
GEDEX	Greenhouse Effect Detection Experiment	
GLAS	Geoscience Laser Altimeter System	
GLIS	Global Land Information System	CH01
GOSIP	Government Open Systems Interconnection Profile	
GSFC	Goddard Space Flight Center	
HALOE	Halogen Occultation Experiment	
HDF	Hierarchical Data Format	
HIRDLS	High-Resolution Dynamics Limb Sounder	
HRDI	High Resolution Doppler Interferometer	
HSB	Humidity Sounder for Brazil	CH06
ICC	Instrument Control Center	
ICF	Instrument Control Facility	
II	Interdisciplinary Investigators	
IP	International Partner	
IPA	Inter-Project Agreement	
ISAMS	Improved Stratospheric and Mesospheric Sounder	
ISCCP	International Satellite Cloud Climatology Project	
ISLSCP	International Satellite Land Surface Climatology Project	
IST	Instrument Support Terminal	
IV&V	Independent Verification and Validation	
IWG	Investigator Working Group	
JERS	Japanese Earth Remote-sensing Satellite	
JPL	Jet Propulsion Laboratory	
LATI	Landsat Advanced Technical Instrument	
LaRC	Langley Research Center	

LIS	Lightning Imaging Sensor CH06
MISR	Multi-angle Imaging SpectroRadiometer
MLS	Microwave Limb Sounder
MODIS	Moderate Resolution Imaging Spectrometer CH06
MOPITT	Measurements of Pollution in the Troposphere
MTPE	Mission to Planet Earth
MR	Microwave Radiator
MRR	Mission Requirements Request
MSS	Multispectral Scanner System
MSFC	Marshall Space Flight Center
MOUs	Memorandum of Understanding
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications
NASDA	National Space Agency
NCC	Network Control Center
NCDS	NASA Climate Data System
NOAA	National Oceanic and Atmospheric Administration
NODS	NASA Ocean Data System
NREN	National Research and Education Network
NSCAT	NASA Scatterometer
NSFnet	National Science Foundation Network
NSI	NASA Science Internet
NSIDC	National Snow and Ice Data Center
NSSDC	NASA Space Science Data Center
ODUS	Ozone Dynamic Ultraviolet Spectrometer
OLS	Operational Line Scan
ORNL	Oak Ridge National Laboratory

OTTer	Oregon Transect Ecosystem Research
PDMP	Program Data Management Plan
PEM	Particle Environment Monitor
PI	Principal Investigator
PLDS	Pilot Land Data System
PR	Precipitation Radar
PSCN	Program Support Communications Network
RadarSAT	Radar Satellite
RFSOC	Radio Frequency Simulations Operations Center
SAGE	Stratospheric Aerosol and Gas Experiment
SAM	Stratospheric Aerosol Measurement
SAR	Synthetic Aperture Radar
SBUV	Solar Backscatter Ultraviolet
SCAT	Scatterometer
SCF	Science Computing Facility
SDPF	Sensor Data Processing Facility
SEDAC	Socio-Economic Data and Applications Center
SeaWiFS	Sea-viewing Wide Field-of-View Sensor
SGS	Svalbard Ground Station CH01
SIRC/XSAR	Shuttle Imaging Radar/X-band Synthetic Aperture Radar
SMMR	Scanning Multichannel Microwave Radiometer
SOC	Simulation Operations Center
SOLSTICE	Solar Stellar Irradiance Comparison Experiment
SSM/I	Special Sensor Microwave/Imager
SUSIM	Solar Ultraviolet Spectral Irradiance Monitor
TBD	To Be Determined
TBR	To Be Resolved CH06
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TES	Tropospheric Emission Spectrometer

TIROS	Television and Infrared Observation Satellite
TOGA-COARE	Tropical Ocean and Global Atmosphere-Coupled Ocean Atmosphere Response Experiment
TOMS	Total Ozone Mapping Spectrometer
TOPEX	Ocean Topography Experiment
TOVS	TIROS Operational Vertical Sounder
TL	Team Leader
TM	Team Member
TMI	TRMM Microwave Imager
TRMM	Tropical Rainfall Measuring Mission
UAF	University of Alaska - Fairbanks
USGCRP	U.S. Global Change Research Program
UARS	Upper Atmosphere Research Satellite
VIRS	Visible and Infrared Spectrometer
WINDII	Wind Imaging Interferometer
WOTS	Wallops Orbital Tracking Station
WGS	Wallops Ground System CH08
WSC	White Sands Complex
V0	Version Zero
V1	Version One
V2	Version Two

APPENDIX D - MISSION SPECIFIC REQUIREMENTS

REQUIREMENTS KEY

Each requirement will be followed by a reference number which provides the following information:

Requirement # a.b.c.d.

Digit a – Spacecraft ID
- 1 – AM1
- 2 – PM1
- 3 – CHEM
- 4 – Deleted
- 5 – LALT
- 6 – AM2
- 7 – PM2
- 8 – AM1 (Prelaunch)

Digit b – Data Stream
- 1 – Commands
- 2 – Planning and Scheduling
- 3 – Housekeeping
- 4 – Science/Instrument Data
- 5 – Operations Management Data
- 6 – NOAA Housekeeping Data
- 7 – NOAA Instrument Science Data

Digit c – Identifies different data rates within the identified data stream.

Digit d – Used as a counter (e.g., number of different requirements having the same data rates within the data stream).

AM-1 MISSION SPECIFIC REQUIREMENTS - ON-ORBIT OPERATIONS

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Commands	10	10	X					EOC	EDOS @ GSFC	TDRSS High Rate Commanding (via SSA)	1.1.1.1	204001	
	10	10	X					EDOS @ GSFC	TDRSS/TGT		1.1.1.2	204002	
	10	10	X					TDRSS	Spacecraft			204279	
	1	1	X					EOC	EDOS @ GSFC	TDRSS Low Rate Commanding (via MA)	1.1.3.1	204006	
	1	1	X					EDOS @ GSFC	TDRSS/TGT		1.1.3.2	204007	
	1	1	X					TDRSS	Spacecraft			204280	
	0.125	0.125	X					EOC	EDOS @ GSFC	TDRSS Contingency Commanding (via SSA)	1.1.4.1	204008	
	0.125	0.125	X					EDOS @ GSFC	TDRSS/TGT		1.1.4.2	204009	
	0.125	0.125	X					TDRSS	Spacecraft			204281	
	2	2	X					EOC	EDOS @ GSFC	WOTS Emergency Commanding	1.1.2.1	204003	
	2	2	X					EDOS @ GSFC	WOTS		1.1.2.2	204004	
	2	2	X					WOTS	Spacecraft			204282	
	2	2	X					EOC	EDOS @ GSFC	EPGS Commanding		204283	CH09
	2	2	X					EDOS @ GSFC	EPGS		1.1.2.3	204005	
	2	2	X					EPGS	Spacecraft			204284	
Housekeeping Data Stream	32	32	X					Spacecraft	TDRSS	Housekeeping via TDRSS S-band (MA or SSA); 16 Kbps each on I and Q channels normally identical. Optionally, data content on Q channel may be Dump/Diagnostic		204285	
	32	32	X					TDRSS/TGT	EDOS @ GSFC		1.3.1.1	204010	
	32	32	X					EDOS @ GSFC	EOC		1.3.1.2	204011	
	32	32	X					EDOS @ GSFC	ASTER GDS*		1.3.1.3	204012	
	32	32	X					Spacecraft	EPGS	EPGS Housekeeping		204287	
	32	32	X					EPGS	EDOS @ GSFC	16 kbps H/K on subcarrier	1.3.1.4	204013	
	32	32	X					EDOS @ GSFC	EOC	16 kbps H/K or dump/diagnostic on	1.3.1.5	204014	
	32	32	X					EDOS @ GSFC	ASTER GDS*		1.3.1.6	204015	
Housekeeping Data Stream	32	32	X					Spacecraft	WOTS	Emergency WOTS Housekeeping		204289	
	32	32	X					WOTS	EDOS @ GSFC	16 kbps H/K on subcarrier	1.3.1.7	204016	
	32	32	X					EDOS @ GSFC	EOC	16 kbps H/K or dump/diagnostic on carrier	1.3.1.8	204017	
	32	32	X					EDOS @ GSFC	ASTER GDS*		1.3.1.9	204018	

* IPs will arrange to pick up the data at the designated U.S. Gateway at their own cost.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC

Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Housekeeping Data Stream	16	16			X			EDOS @ GSFC	EOC	Playback housekeeping data from the science data stream	1.3.2.1	204019	
	16	16			X			EDOS @ GSFC	ASTER GDS*		1.3.2.2	204020	
	16	NA					X	EDOS @ GSFC	GSFC DAAC	Diagnostic and Merged Housekeeping (R/T and P/B) PDSs are provided. ASTER does not receive diagnostic (dump) data. 100% of ASTER	1.3.2.3	204021	
	16	NA					X	EDOS @ GSFC	ASTER GDS	data delivered as physical media	1.3.2.4	204022	
	272	272	X					Spacecraft	TDRSS	TDRSS housekeeping. 256 kbps H/K playback on Q channel. 16 kbps H/K on I channel		204290	
	256	256	X					TDRSS/TGT	EDOS @ GSFC		1.3.3.1	204023	
	16	16	X					TDRSS/TGT	EDOS @ GSFC			204293	CH09
	16	16	X					EDOS @ GSFC	EOC			204294	
	256	256			X			EDOS @ GSFC	EOC		1.3.3.2	204024	
	256	256			X			EDOS @ GSFC	ASTER GDS*		1.3.3.3	204025	
	528	528	X					Spacecraft	EPGS	EPGS housekeeping. 16 kbps H/K on		204295	
	16	16	X					EPGS	EDOS @ GSFC			204298	
	512	512	X					EPGS	EDOS @ GSFC		1.3.4.1	204026	
	16	16	X					EDOS @ GSFC	EOC			204299	
	512	512			X			EDOS @ GSFC	EOC		1.3.4.2	204027	
	512	512			X			EDOS@ GSFC	ASTER GDS*		1.3.4.3	204028	
Housekeeping Data Stream	528	528	X					Spacecraft	WOTS	WOTS Emergency housekeeping. 16 kbps H/K on subcarrier. 512 kbps H/K playback on carrier		204300	
	16	16	X					WOTS	EDOS @ GSFC			204301	
	512	512		X				WOTS	EDOS @ GSFC		1.3.4.4	204029	
	16	16	X					EDOS @ GSFC	EOC			204302	
	512	512			X			EDOS @ GSFC	EOC		1.3.4.5	204030	
	512	512			X			EDOS @ GSFC	ASTER GDS*		1.3.4.6	204031	
	2	2	X					Spacecraft	TDRSS	Contingency health and safety		204303	
	2	2	X					TDRSS/TGT	EDOS @ GSFC	1 kbps H/K on I channel	1.3.5.1	204032	
	2	2	X					EDOS @ GSFC	EOC	1 kbps H/K or dump diagnostic on Q channel	1.3.5.2	204033	
	2	2	X					EDOS @ GSFC	ASTER GDS*		1.3.5.3	204034	

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Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

AM-1 MISSION SPECIFIC REQUIREMENTS - ON-ORBIT OPERATIONS (Cont.)

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Science Data Stream	18361	111076	X					Spacecraft	TDRSS	Playback rate from spacecraft to TDRSS is 75 Mbps on I & Q (150 Mbps total) over K-band. Science data rates including housekeeping data stream (16 kbps) and ancillary data.	1.4.1.1	204035	CH-09
	18361	111076	X					TDRSS/TGT	EDOS @ WSC			204304	
	18361	NA		X				EDOS @ WSC	EDOS @ GSFC		1.4.2.1	204037	
	18361	111076	X					Spacecraft	EPGS	Downlink rate from spacecraft to EPGS is 150 Mbps over X-band	1.4.1.2	204036	CH06
	18361	111076	X					EPGS	EDOS @ EPGS	(EPGS Phase 2)		204305	CH09
	18361	NA		X				EDOS @ EPGS	EDOS @ GSFC	(EPGS Phase 2)	1.4.2.2	204038	CH06
	NA	NA		X				EPGS	EDOS @ GSFC	Delivered as physical media (Phase 1)	1.4.1.4	204040	CH06
Ancillary Data	0.632	NA					X	EDOS @ GSFC	LaRC DAAC, GSFC DAAC	(632 bits) per second	1.4.3.1	204041	
	0.632	NA					X	EDOS @ GSFC	ASTER GDS	Delivered as physical media	1.4.3.2	204042	
ASTER	8300	89200				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 1 minute at 89.2 Mbps	1.4.4.1	204043	
	8300	NA					X	EDOS @ GSFC	ASTER GDS	100% of ASTER data delivered as physical media	1.4.4.2	204044	
CERES	20	20				X		EDOS @ GSFC	LaRC DAAC	Exp: up to 5 minutes at 20 Kbps once every orbit not to exceed 2% daily	1.4.5.1	204045	
	20	20				X		EDOS @ GSFC	NOAA/MD		1.4.5.2	204046	CH06
	20	NA					X	EDOS @ GSFC	LaRC DAAC		1.4.5.3	204047	
MISR	3800	11000				X		EDOS @ GSFC	LaRC DAAC	Exp: up to 5 minutes at 9.0 Mbps once every orbit not to exceed 2% daily average (6.6 Gbits/day)	1.4.6.1	204048	CH09
	3800	NA					X	EDOS @ GSFC	LaRC DAAC		1.4.6.2	204049	
MODIS	6200	10800				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 5 minutes at 11 Mbps once every orbit not to exceed 2% daily average (10.7 Gbits/day)	1.4.7.1	204050	
	6200	NA					X	EDOS @ GSFC	GSFC DAAC		1.4.7.2	204051	
	6200	10800			X			EDOS @ GSFC	NOAA/MD	Pick up of rate-buffered data from EDOS is the responsibility of NOAA	1.4.7.3	204266	CH06
MOPITT	25	40				X		EDOS @ GSFC	LaRC DAAC	Exp: up to 5 minutes at 25 Kbps once every orbit not to exceed 2% daily average (43.2 Mbits/day)	1.4.8.1	204052	CH09
	25	NA					X	EDOS @ GSFC	LaRC DAAC		1.4.8.2	204053	
AM-1 Spacecraft Trash Buffer	NA	NA			X			EDOS @ GSFC	EOC	Trash buffer via Ku-band for anomaly investigation. Buffer contains data with invalid VCIDs (maximum value of buffer is 1.46 Gbits)	1.5.2.1	204054	

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Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

PM-1 MISSION SPECIFIC REQUIREMENTS - ON-ORBIT OPERATIONS

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Commands	2	2	X					EOC	EDOS @ GSFC	EPGS Normal Commanding	2.1.1.1	204055	CH06
	2	2	X					EDOS @ GSFC	EPGS		2.1.1.2	204056	CH06
	2	2	X					EDOS @ GSFC	WOTS	WOTS Emergency Commanding	2.1.1.3	204057	CH01,06
	0.125	0.125	X					EOC	EDOS @ GSFC	TDRSS Contingency Commanding	2.1.2.1	204058	
	0.125	0.125	X					EDOS @ GSFC	TDRSS		2.1.2.2	204059	
	0.25	0.25	X					EOC	EDOS @ GSFC		2.1.2.3	204267	CH06
	0.25	0.25	X					EDOS @ GSFC	TDRSS		2.1.2.4	204268	CH06
	0.5	0.5	X					EOC	EDOS @ GSFC		2.1.2.5	204269	CH06
	0.5	0.5	X					EDOS @ GSFC	TDRSS		2.1.2.6	204270	CH06
	1	1	X					EOC	EDOS @ GSFC		2.1.2.7	204271	CH06
	1	1	X					EDOS @ GSFC	TDRSS		2.1.2.8	204272	CH06
Housekeeping Data Stream@	16	16	X					EPGS	EDOS @ GSFC	Normal Housekeeping.	2.3.1.1	204060	CH06
	16	16	X					EDOS @ GSFC	EOC		2.3.1.2	204061	CH06
	16	16	X					WOTS	EDOS @ GSFC	Emergency Housekeeping	2.3.1.3	204062	CH01, 06
	16	16	X					EDOS @ GSFC	EOC		2.3.1.4	204063	CH06
	8	8	X					TDRSS	EDOS @ GSFC	Scheduled for tracking support. 4 Kbps each on I and Q channels normally identical.	2.3.1.5	204064	CH06
	8	8	X					EDOS @ GSFC	EOC		2.3.1.6	204065	CH06
	24	24			X			EDOS @ GSFC	EOC	Housekeeping data from the science data stream	2.3.2.1	204066	
	24	NA					X	EDOS @ GSFC	GSFC DAAC	Merged housekeeping data	2.3.2.2	204067	
	524	524		X				WOTS	EDOS @ GSFC	Emergency playback	2.3.3.1	204068	CH01, 06
	524	524			X			EDOS @ GSFC	EOC		2.3.3.2	204069	CH06
	524	524	X					EPGS	EDOS @ GSFC	Normal Playback	2.3.3.3	204070	CH06
	524	524			X			EDOS @ GSFC	EOC		2.3.3.4	204071	CH06
	2	2	X					TDRSS	EDOS @ GSFC	Contingency health and safety.	2.3.4.1		CH06
	2	2	X					EDOS@GSFC	EOC	Each bit stream (1 or 4 Kbps) on I and Q channels nomally identical	2.3.4.2	203073	
	8	8	X					TDRS	EDOS@GSFC		2.3.4.3	204273	CH06
	8	8	X					EDOS @ GSFC	EOC		2.3.4.4	204274	CH06

@ Could contain separate engineering and ancillary packets.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and	Rate Buffered	Exp (2)	Level-0						
Science Data Stream (Downlink rate	7797.4 Eng:24.1	12397.4 Eng:24.0	X					Spacecraft	EPGS	Science Data rates include Engineering Data Stream (24 kbps)	2.4.1.1	204074	CH06
	7821.4	N/A		X				EPGS	EDOS @ GSFC		2.4.2.1	204075	CH06
AIRS	1440	1440				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 5 minutes at 1.44 Mbps once every orbit not to exceed 2% daily average (2.5 Gbits/day)	2.4.3.1	204076	
	1440	NA					X	EDOS @ GSFC	GSFC DAAC		2.4.3.2	204077	
AMSU-A	3.2	3.2				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 5 minutes at 3.2 Kbps once every orbit not to exceed 2% daily average (5.5 Mbits/day)	2.4.4.1	204078	
	3.2	NA					X	EDOS @ GSFC	GSFC DAAC		2.4.4.2	204079	
CERES	20	20				X		EDOS @ GSFC	LaRC DAAC	Exp: up to 5 minutes at 20 Kbps once every orbit not to exceed 2% daily average (34.6 Mbits/day)	2.4.5.1	204080	
	20	NA					X	EDOS @ GSFC	LaRC DAAC		2.4.5.2	204081	
HSB	4.2	4.2				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 5 minutes at 4.2 Kbps once every orbit not to exceed 2% daily average (7.3 Mbits/day)	2.4.6.1	204082	CH06
	4.2	NA					X	EDOS @ GSFC	GSFC DAAC		2.4.6.2	204083	
AMSR-E	130	130				X		EDOS @ GSFC	TBS DAAC	Exp: up to 5 minutes at 130 Kbps once every orbit not to exceed 2% daily average (225 Mbits/day)	2.4.7.1	204084	CH06
	130	NA					X	EDOS @ GSFC	TBS DAAC		2.4.7.2	204085	
MODIS	6200	10800				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 5 minutes at 11.0 Mbps once every orbit not to exceed 2% daily average (10.7 Gbits/day)	2.4.8.1	204086	
	6200	NA					X	EDOS @ GSFC	GSFC DAAC		2.4.8.2	204087	

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.
(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

*NOAA PROCESSING REQUIREMENTS - PM 1

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and	Rate Buffered	Exp (2)	Level-0						
Housekeeping Data Stream@	24	24			X			EDOS @ GSFC	NOAA	For Supporting Data Analysis	2.6.1.1	204088	
AIRS	1440	1440			X			EDOS @ GSFC	NOAA		2.7.1.1	204089	
AMSU-A	3.2	3.2			X			EDOS @ GSFC	NOAA		2.7.2.1	204090	
CERES	20	20				X		EDOS @ GSFC	NOAA		2.7.3.1	204091	CH06
HSB	4.2	4.2			X			EDOS @ GSFC	NOAA		2.7.4.1	204092	CH06
AMSR-E	130	130			X			EDOS @ GSFC	NOAA		2.7.5.1	204093	CH06
MODIS	6200	10800			X			EDOS @ GSFC	NOAA		2.7.6.1	204094	

@ Could contain separate engineering and ancillary packets.

* It is NOAA's responsibility to pick up the data from EDOS.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility providing rate buffering services
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

CHEMISTRY MISSION SPECIFIC REQUIREMENTS - ON-ORBIT OPERATIONS

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Commands	2	2	X					EOC	EDOS @ GSFC	EPGS Normal Commanding	3.1.1.1	204095	CH06
	2	2	X					EDOS @ GSFC	EPGS		3.1.1.2	204096	CH06
	2	2	X					EDOS @ GSFC	WOTS	WOTS Emergency Commanding	3.1.1.3	204097	CH01, 06
	0.125	0.125	X					EOC	EDOS @ GSFC	TDRSS Contingency Commanding	3.1.2.1	204098	
	0.125	0.125	X					EDOS @ GSFC	TDRSS		3.1.2.2	204099	
Housekeeping	16	16	X					EPGS	EDOS @ GSFC	Normal Housekeeping	3.3.1.1	204100	CH06
	16	16	X					EDOS @ GSFC	EOC		3.3.1.2	204101	CH06
	16	16	X					WOTS	EDOS @ GSFC	Emergency Housekeeping	3.3.1.3	204102	CH01, 06
	16	16	X					EDOS @ GSFC	EOC		3.3.1.4	204103	CH06
	32	32	X					TDRSS	EDOS @ GSFC	Scheduled for tracking support. Other uses optional. 16 Kbps each on I and Q channels normally identical	3.3.1.5	204104	CH06
	32	32	X					EDOS @ GSFC	EOC		3.3.1.6	204105	
	16	16			X			EDOS @ GSFC	EOC	Housekeeping data from the science data stream	3.3.2.1	204106	
	16	NA					X	EDOS @ GSFC	GSFC DAAC	Merged housekeeping data	3.3.2.2	204107	
	512	512		X				WOTS	EDOS @ GSFC	Emergency playback	3.3.3.1	204108	CH01, 06
	512	512			X			EDOS @ GSFC	EOC		3.3.3.2	204109	
	512	512	X					EPGS	EDOS @ GSFC	Normal Playback	3.3.3.3	204110	CH06
	512	512			X			EDOS @ GSFC	EOC		3.3.3.4	204111	
	2	2	X					TDRSS	EDOS @ GSFC	Contingency health and safety	3.3.4.1	204112	CH06
	2	2	X					EDOS @ GSFC	EOC	1 Kbps each on I and Q channels normally identical.	3.3.4.2	204113	CH06

@ Could contain separate engineering and ancillary packets.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

CHEMISTRY MISSION SPECIFIC REQUIREMENTS - ON-ORBIT OPERATIONS (Cont.)

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real	Store	Rate	Exp (2)	Level-						
Science Data	3440 +	19860 +	X					Spacecraft	EPGS	Science Data rates include	3.4.1.1	204114	CH06
	3456	N/A		X				EPGS	EDOS @ GSFC		3.4.2.1	204115	CH06
HIRDLS	50	100				X		EDOS @ GSFC	GSFC DAAC	Exp as needed, up to 2% daily	3.4.3.1	204116	
	50	NA					X	EDOS@GSFC	GSFC DAAC		3.4.3.2	204117	
	50	100			X			EDOS @ GSFC	NOAA/MD	Pick up of rate-buffered data from EDOS is NOAA's responsibility	3.4.3.3	204275	CH06
TES	3240	19500				X		EDOS @ GSFC	LaRC DAAC	Exp as needed, up to 2% daily average (5.6 Gbits/day)	3.4.4.1	204118	
	3240	NA					X	EDOS @ GSFC	LaRC DAAC		3.4.4.2	204119	
MLS	100	100				X		EDOS @ GSFC	GSFC DAAC	Exp as needed, up to 2% daily average (172.8 Mbits/day). 100 Kbps twice per orbit for 8 minutes	3.4.5.1	204120	
	100	NA					X	EDOS @ GSFC	LaRC DAAC		3.4.5.2	204121	
ODUS	50	160				X		EDOS @ GSFC	TBD DAAC	Exp as needed, up to 2% daily average (86.4 Mbits/day)	3.4.6.1	204122	
	50	NA					X	EDOS @ GSFC	TBD DAAC		3.4.6.2	204123	

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real	Store	Rate	Exp (2)	Level-						
Commands	2	2	X					EOC	EDOS @ GSFC	EPGS	5.1.1.1	204124	CH06
	2	2	X					EDOS @ GSFC	EPGS		5.1.1.2	204125	CH06
	2	2	X					EDOS @ GSFC	WOTS	WOTS Emergency Commanding	5.1.1.3	204126	CH01, 06
	0.125	0.125	X					EOC	EDOS @ GSFC	TDRSS Contingency Commanding	5.1.2.1	204127	
	0.125	0.125	X					EDOS @ GSFC	TDRSS		5.1.2.2	204128	
Housekeeping Data Stream@	16	16	X					EPGS	EDOS @ GSFC	Normal Housekeeping	5.3.1.1	204129	CH06
	16	16	X					EDOS @ GSFC	EOC		5.3.1.2	204130	CH06
	16	16	X					WOTS	EDOS @ GSFC	Emergency Housekeeping	5.3.1.3	204131	CH01, 06
	16	16	X					EDOS @ GSFC	EOC		5.3.1.4	204132	
	32	32	X					TDRSS	EDOS @ GSFC	Scheduled for tracking support. Other uses optional. 16 Kbps each on I and Q channels normally identical.	5.3.1.5	204133	CH06
	32	32	X					EDOS @ GSFC	EOC		5.3.1.6	204134	
	16	16			X			EDOS @ GSFC	EOC	Housekeeping data from the science data stream	5.3.2.1	204135	
	16	NA					X	EDOS @ GSFC	GSFC DAAC	Merged housekeeping data	5.3.2.2	204136	
	512	512		X				WOTS	EDOS @ GSFC	Emergency playback	5.3.3.1	204137	CH01, 06
	512	512			X			EDOS @ GSFC	EOC		5.3.3.2	204138	
	512	512	X					EPGS	EDOS @ GSFC	Normal Playback	5.3.3.3	204139	CH06
	512	512			X			EDOS @ GSFC	EOC		5.3.3.4	204140	
	2	2	X					TDRSS	EDOS @ GSFC	Contingency health and safety	5.3.4.1	204141	CH06
	2	2	X					EDOS @ GSFC	EOC	1 Kbps each on I and Q channels normally identical	5.3.4.2	204142	CH06
Science Data	206 +	206 +	X					Spacecraft	EPGS	Science data rates include	5.4.1.1	204143	CH06
	222	N/A		X				EPGS	EDOS @ GSFC		5.4.2.1	204144	CH06
GLAS	206	206				X		EPGS	GSFC DAAC	Exp as needed, up to 2% daily average (356 Mbits/day)	5.4.3.1	204145	CH06
	206	206					X	EPGS	GSFC DAAC		5.4.3.2	204146	CH06

@ Could contain separate engineering and ancillary packets.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC

Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

AM-2 MISSION SPECIFIC REQUIREMENTS - ON-ORBIT OPERATIONS

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Commands	2	2	X					EOC	EDOS @ GSFC	EPGS	6.1.1.1	204147	CH06
	2	2	X					EDOS @ GSFC	EPGS		6.1.1.2	204148	CH06
	2	2	X					EDOS @ GSFC	WOTS	WOTS Emergency Commanding	6.1.1.3	204149	CH01, 06
	0.125	0.125	X					EOC	EDOS @ GSFC	TDRSS Contingency Commanding	6.1.2.1	204150	
	0.125	0.125	X					EDOS @ GSFC	TDRSS		6.1.2.2	204151	
Housekeeping Data Stream@	16	16	X					EPGS	EDOS @ GSFC	Normal Housekeeping	6.3.1.1	204152	CH06
	16	16	X					EDOS @ GSFC	EOC		6.3.1.2	204153	CH06
	16	16	X					WOTS	EDOS @ GSFC	Emergency Housekeeping	6.3.1.3	204154	CH01
	16	16	X					EDOS @ GSFC	EOC		6.3.1.4	204155	CH06
	32	32	X					TDRSS	EDOS @ GSFC	Scheduled for tracking support. Other uses optional. 16 Kbps each on I and Q channels normally identical	6.3.1.5	204156	CH06
	32	32	X					EDOS @ GSFC	EOC		6.3.1.6	204157	
	16	16			X			EDOS @ GSFC	EOC	Housekeeping data from the science data stream	6.3.2.1	204158	
	16	NA					X	EDOS @ GSFC	GSFC DAAC	Merged housekeeping data	6.3.2.2	204159	
	512	512		X				WOTS	EDOS @ GSFC	Emergency playback	6.3.3.1	204160	CH01, 06
	512	512			X			EDOS @ GSFC	EOC		6.3.3.2	204161	
	512	512	X					EPGS	EDOS @ GSFC	Normal Playback	6.3.3.3	204162	CH06
	512	512			X			EDOS @ GSFC	EOC		6.3.3.4	204163	
	2	2	X					TDRSS	EDOS @ GSFC	Contingency health and safety	6.3.4.1	204164	CH06
	2	2	X					EDOS @ GSFC	EOC	1 Kbps each on I and Q channels normally identical	6.3.4.2	204165	CH06

@ Could contain separate engineering and ancillary packets.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Science Data Stream (Downlink rate from spacecraft is 3 X 150 Mbps)	38850 + HK:16	TBD + HK:16	X					Spacecraft	EPGS	Science data rates include Housekeeping data stream (16 kbps)	6.4.1.1	204166	CH06
	38866	N/A		X				EPGS	EDOS @ GSFC		6.4.2.1	204167	CH06
CERES	10	10				X		EDOS @ GSFC	LaRC DAAC	Exp as needed, up to 2% daily average (17.3 Mbits/day)	6.4.3.1	204168	
	10	NA					X	EDOS@GSFC	LaRCDAAC		6.4.3.2	204169	
	10	10				X		EDOS @ GSFC	NOAA		6.4.3.3	204276	CH06
MISR	3000	TBD				X		EDOS @ GSFC	LaRC DAAC	Exp as needed, up to 2% daily average (5.2 Gbits/day)	6.4.4.1	204170	
	3000	NA					X	EDOS @ GSFC	LaRC DAAC		6.4.4.2	204171	
LATT (PAN+6 color)	26500	TBD				X		EDOS @ GSFC	EDC DAAC	Exp as needed, up to 2% daily average (45.8 Gbits/day)	6.4.5.1	204172	
	26500	NA					X	EDOS @ GSFC	EDC DAAC		6.4.5.2	204173	
MODIS (36 bands)	5340	TBD				X		EDOS @ GSFC	GSFC DAAC	Exp as needed, up to 2% daily average (9.2 Gbits/day)	6.4.6.1	204174	
	5340	NA					X	EDOS@GSFC	GSFC DAAC		6.4.6.2	204175	
	5340	TBD			X			EDOS @ GSFC	NOAA/MD	Pick up of rate-buffered data from EDOS is NOAA's responsibility	6.4.6.3	204277	CH06
CAL	4000	TBD				X		EDOS @ GSFC	LaRC DAAC	Exp as needed, up to 2% daily average (6.9 Gbits/day).	6.4.7.1	204176	
	4000	NA					X	EDOS @ GSFC	LaRC DAAC		6.4.7.2	204177	

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

PM-2 MISSION SPECIFIC REQUIREMENTS - ON-ORBIT OPERATIONS

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Commands	2	2	X					EOC	EDOS @ GSFC	EPGS Normal Commanding	7.1.1.1	204178	CH06
	2	2	X					EDOS @ GSFC	EPGS		7.1.1.2	204179	CH06
	2	2	X					EDOS @ GSFC	WOTS	WOTS Emergency Commanding	7.1.1.3	204180	CH01, 06
	0.125	0.125	X					EOC	EDOS @ GSFC	TDRSS Contingency Commanding	7.1.2.1	204181	
	0.125	0.125	X					EDOS @ GSFC	TDRSS		7.1.2.2	204182	
Housekeeping Data Stream@	16	16	X					EPGS	EDOS @ GSFC	Normal Housekeeping	7.3.1.1	204183	CH06
	16	16	X					EDOS @ GSFC	EOC		7.3.1.2	204184	CH06
	16	16	X					WOTS	EDOS @ GSFC	Emergency Housekeeping	7.3.1.3	204185	CH01, 06
	16	16	X					EDOS @ GSFC	EOC		7.3.1.4	204186	CH06
	32	32	X					TDRSS	EDOS @ GSFC	Scheduled for tracking support. Other uses optional. 16 Kbps each on I and Q channels normally identical	7.3.1.5	204187	CH06
	32	32	X					EDOS @ GSFC	EOC		7.3.1.6	204188	
	16	16			X			EDOS @ GSFC	EOC	Housekeeping data from the science data stream	7.3.2.1	204189	
	16	NA					X	EDOS @ GSFC	GSFC DAAC	Merged housekeeping data	7.3.2.2	204190	
	512	512		X				WOTS	EDOS @ GSFC	Emergency playback	7.3.3.1	204191	CH01
	512	512			X			EDOS @ GSFC	EOC		7.3.3.2	204192	
	512	512	X					EPGS	EDOS @ GSFC	Normal Playback	7.3.3.3	204193	CH06
	512	512			X			EDOS @ GSFC	EOC		7.3.3.4	204194	
	2	2	X					TDRSS	EDOS @ GSFC	Contingency health and safety	7.3.4.1	204195	CH06
	2	2	X					EDOS @ GSFC	EOC	1 Kbps each on I and Q channels normally identical	7.3.4.2	204196	CH06

@ Could contain separate engineering and ancillary packets.

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Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

PM-2 MISSION SPECIFIC REQUIREMENTS - ON-ORBIT OPERATIONS (Cont.)

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Science Data Stream (Downlink rate from spacecraft is 150 Mbps)	7787.4 + Eng:24	12387.4 + Eng:24	X					Spacecraft	EPGS	Science data rates include housekeeping data stream (24 Kbps)	7.4.1.1	204197	CH06
	7811.4	N/A		X				EPGS	EDOS @ GSFC		7.4.2.1	204198	CH06
AIRS	1440	1440				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 5 minutes at 1.44 Mbps once every orbit not to exceed 2% daily average (2.5 Gbits/day)	7.4.3.1	204199	
	1440	NA					X	EDOS @ GSFC	GSFC DAAC		7.4.3.2	204200	
AMSU-A	3.2	3.2				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 5 minutes at 3.2 Kbps once every orbit not to exceed 2% daily average (5.5 Mbits/day)	7.4.4.1	204201	
	3.2	NA					X	EDOS @ GSFC	GSFC DAAC		7.4.4.2	204202	
CERES	10	10				X		EDOS @ GSFC	LaRC DAAC	Exp: up to 5 minutes at 10 Kbps once every orbit not to exceed 2% daily average (17.3 Mbits/day)	7.4.5.1	204203	
	10	NA					X	EDOS @ GSFC	LaRC DAAC		7.4.5.2	204204	
HSB	4.2	4.2				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 5 minutes at 4.2 Kbps once every orbit not to exceed 2% daily average (7.3 Mbits/day)	7.4.6.1	204205	CH06
	4.2	NA					X	EDOS @ GSFC	GSFC DAAC		7.4.6.2	204206	
AMSR-E	130	130				X		EDOS @ GSFC	TBS DAAC	Exp: up to 5 minutes at 130 Kbps once every orbit not to exceed 2% daily average (225) Mbits/day)	7.4.7.1	204207	CH06
	130	NA					X	EDOS @ GSFC	TBS DAAC		7.4.7.2	204208	
MODIS	6200	10800				X		EDOS @ GSFC	GSFC DAAC	Exp: up to 5 minutes at 11.0 Mbps once every orbit not to exceed 2% daily average (10.7 Gbits/day)	7.4.8.1	204209	
	6200	NA					X	EDOS @ GSFC	GSFC DAAC		7.4.8.2	204210	

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(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

*NOAA PROCESSING REQUIREMENTS - PM-2

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Housekeeping Data Stream@	24	24			X			EDOS @ GSFC	NOAA	For supporting data analysis	7.6.1.1	204211	
AIRS	1440	1440			X			EDOS @ GSFC	NOAA		7.7.1.1	204212	
AMSU-A	3.2	3.2			X			EDOS @ GSFC	NOAA		7.7.2.1	204213	
HSB	4.2	4.2			X			EDOS @ GSFC	NOAA		7.7.3.1	204214	CH06
MODIS	6200	10800			X			EDOS @ GSFC	NOAA		7.7.4.1	204215	
AMSR-E	130	130			X			EDOS @ GSFC	NOAA		7.7.5.1	204216	CH06
CERES	10	10				X		EDOS @ GSFC	NOAA		7.7.6.1	204217	CH06

@ Could contain separate engineering and ancillary packets.

* It is NOAA's responsibility to pick up the data from EDOS

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

AM-1 MISSION SPECIFIC REQUIREMENTS - PRE-LAUNCH OPERATIONS

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #	
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0					
Commands	10	10	X					EOC	EDOS @ GSFC	Ground System Compatibility Tests	8.1.1.1	204218
	10	10	X					EDOS @ GSFC	Integrated S/C at Valley Forge	Full E-to-E Test and Final S/C Comprehensive Performance Tests with the S/C at Valley Forge**	8.1.1.2	204219
	10	10	X					EDOS @ GSFC	Integrated S/C at VAFB	Tests with the S/C at VAFB	8.1.1.3	204220
	2	2	X					EOC	EDOS @ GSFC	Ground System Compatibility Tests	8.1.2.1	204221
	2	2	X					EDOS @ GSFC	Integrated S/C at Valley Forge	Full E-to-E Test and Final S/C Comprehensive Performance Tests with the S/C at Valley Forge**	8.1.2.2	204222
	2	2	X					EDOS @ GSFC	Integrated S/C at VAFB	Tests with the S/C at VAFB	8.1.2.3	204223
	2	2	X					EDOS @ GSFC	EPGS, WOTS	Ground System Compatibility Tests	8.1.2.4	204224 CH01, 06
	1	1	X					EOC	EDOS @ GSFC	Ground System Compatibility Tests	8.1.3.1	204225
	1	1	X					EDOS @ GSFC	Integrated S/C at Valley Forge	Full E-to-E Test and Final Spacecraft Comprehensive Performance Tests with the S/C at Valley Forge**	8.1.3.2	204226
	1	1	X					EDOS @ GSFC	Integrated S/C at VAFB	Tests with the S/C at VAFB	8.1.3.3	204227
	0.125	0.125	X					EOC	EDOS @ GSFC	Ground System Compatibility Tests	8.1.4.1	204228
	0.125	0.125	X					EDOS @GSFC	Integrated S/C at Valley Forge	Full E-to-E Test and Final S/C Comprehensive Performance Tests with the S/C at Valley Forge**	8.1.4.2	204229
	0.125	0.125	X					EDOS @ GSFC	Integrated S/C at VAFB	Tests with the S/C at VAFB	8.1.4.3	204230

** RF link will be used between TGTs and the S/C at Valley Forge.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

AM-1 MISSION SPECIFIC REQUIREMENTS - PRE-LAUNCH OPERATIONS (Cont.)

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #	
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0					
Housekeeping Data Stream	32	32	X					Integrated S/C at Valley Forge	EDOS @ GSFC	Full E-to-E Test and Final S/C Comprehensive Performance Tests with the S/C at Valley Forge**	8.3.1.1	204231
	32	32	X					Integrated S/C at VAFB	EDOS @ GSFC	Tests with the S/C at VAFB	8.3.1.2	204232
	32	32	X					EDOS @ GSFC	EOC	Ground System Compatibility Tests; Ground System E-to-E Tests; Compatibility and Full E-to-E Tests with S/C at Valley Forge**	8.3.1.3	204233
	32	32	X					EPGS, WOTS	EDOS @ GSFC	Ground System Compatibility Tests	8.3.1.4	204234 CH01, 06
	32	32	X					EDOS @ GSFC	ASTER GDS*	Ground System Compatibility Tests; Ground System E-to-E Tests; Compatibility and Full E-to-E Tests with S/C at Valley Forge** and VAFB	8.3.1.5	204235
	16	NA					X	EDOS @ GSFC	GSFC DAAC	Ground System Compatibility Tests and Ground System E-to-E Tests. Merged housekeeping data.	8.3.2.1	204236
	16	16			X			EDOS @ GSFC	EOC	(Part of Ku-band Science Stream). Ground System Compatibility Tests; Ground System E-to-E Tests	8.3.2.2	204237
	16	16			X			EDOS @ GSFC	ASTER GDS*	(Part of Ku-band Science Stream). Compatibility and Full E-to-E Tests with S/C at Valley Forge**	8.3.2.3	204238

* IPs will arrange to pick up data at the designated U.S. Gateway at their own cost.

** RF link will be used between TGTs and the S/C at Valley Forge.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC

Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

AM-1 MISSION SPECIFIC REQUIREMENTS - PRE-LAUNCH OPERATIONS (Cont.)

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Housekeeping Data Stream	272	272	X					Integrated S/C at Valley Forge	EDOS @ GSFC	Full E-to-E Test and Final S/C Comprehensive Performance Tests with the S/C at Valley Forge**	8.3.3.1	204239	
	256	256			X			EDOS @ GSFC	EOC	Ground System Compatibility Tests; Ground System E-to-E Tests; Compatibility and Full E-to-E Tests with S/C at Valley Forge**	8.3.3.2	204240	
	256	256			X			EDOS @ GSFC	ASTER GDS*		8.3.3.3	204241	
	512	512		X				EPGS, WOTS	EDOS @ GSFC	Ground System Compatibility Tests and Full E-to-E Tests	8.3.4.1	204242	CH01, 06
	512	512			X			EDOS @ GSFC	EOC	Ground System Compatibility Tests; Ground System E-to-E Tests; Compatibility and Full E-to-E Tests with S/C at Valley Forge**	8.3.4.2	204243	
	512	512			X			EDOS @ GSFC	ASTER GDS*		8.3.4.3	204244	

2	2	X					Integrated S/C at Valley Forge	EDOS @ GSFC	Full E-to-E Test and Final S/C Comprehensive Performance Tests with the S/C at Valley Forge**	8.3.5.1	204245
2	2	X					Integrated S/C at VAFB	EDOS @ GSFC	Tests with the S/C at VAFB	8.3.5.2	204246
2	2	X					EDOS @ GSFC	EOC	Ground System Compatibility Tests; Ground System E-to-E Tests; Compatibility and Full E-to-E Tests with S/C at Valley Forge**	8.3.5.3	204247

	2	2	X					EDOS @ GSFC	ASTER GDS*		8.3.5.4	204248

* IPs will arrange to pick up data at the designated U.S. Gateway at their own cost.

** RF link will be used between TGTs and the S/C at Valley Forge.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

AM-1 MISSION SPECIFIC REQUIREMENTS - PRE-LAUNCH OPERATIONS (Cont.)

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #		
	Average	Peak	Real time	Store and Fwd	Rate Buffered (1)	Exp (2)	Level-0						
Science Data Stream (Downlink rate from spacecraft is 150 Mbps)	18345 + HK:16	109045 + HK:16						ETS/Replay of tape data	EDOS @ WSC	Ground System Compatibility Test and Ground System E-to-E Tests	8.4.1.1	204249	
	18361	109061						Integrated S/C at Valley Forge	EDOS @ WSC	Playback Data. Compatibility and Full E-to-E Tests**	8.4.1.2	204250	
	18361	N/A		X				EDOS @ WSC	EDOS @ GSFC		8.4.2.1	204251	
	NA	NA						EPGS	EDOS @ GSFC	Test compatibility of backup GS tapes	8.4.1.3	204252	CH06
Ancillary Data	0.632	NA					X	EDOS @ GSFC	LaRC DAAC,GSFC DAAC	Ground system end-to-end tests	8.4.3.1	204253	
	0.632	NA					X	EDOS @ GSFC	ASTER GDS*	Delivered as physical media	8.4.3.2	204254	
ASTER	8300	89200				X		EDOS @ GSFC	GSFC DAAC		8.4.4.1	204255	
	8300	NA					X	EDOS @ GSFC	ASTER GDS*	Data Delivered via Physical Media. Ground System Compatibility Tests and Ground System E-to-E Tests	8.4.4.2		
CERES	20	20				X		EDOS @ GSFC	NOAA/MD		8.4.5.1	204256	CH06
	20	20				X		EDOS @ GSFC	LaRC DAAC		8.4.5.2	204257	
	20	NA					X	EDOS @ GSFC	LaRC DAAC		8.4.5.3	204258	
MISR	3800	9000				X		EDOS @ GSFC	LaRC DAAC		8.4.6.1	204259	
	3800	NA					X	EDOS @ GSFC	LaRC DAAC		8.4.6.2	204260	
MODIS	6200	10800				X		EDOS @ GSFC	GSFC DAAC		8.4.7.1	204261	CH06
	6200	NA					X	EDOS@GSFC	GSFC DAAC		8.4.7.2	204262	
	6200	10800			X			EDOS @ GSFC	NOAA/MD	Pick up of rate-buffered data from EDOS is NOAA's responsibility	8.4.7.3	204278	CH06
MOPITT	25	25				X		EDOS @ GSFC	LaRC DAAC		8.4.8.1	204263	
	25	NA					X	EDOS @ GSFC	LaRC DAAC		8.4.8.2	204264	
												204265	

* IPs will arrange to pick up data at the designated U.S. Gateway at their own cost.

** RF link will be used between TGTs and the S/C at Valley Forge.

(1) Rate buffered data delivery to be initiated within 5 minutes after receipt of all data at the EDOS facility at GSFC
Rate buffered delivery of housekeeping data will occur via file transfers using the available bandwidth.

(2) Expedited (EXP) data to be delivered within 3 hours of a completed spacecraft contact session.

NOTE: Some testing of the ground system may utilize recorded data from the integrated spacecraft.

L7 MISSION SPECIFIC REQUIREMENTS - ON-ORBIT OPERATIONS

	Data Rate (Kbps)		Processing Requirements					From	To	Comments	Req. #	
	Average	Peak	Real time	Store and Fwd	Rate Buffered	Exp	Level-0					
Commands	2	2	X					L7 MOC	EPGS	EPGS Commanding	1.1.1.1	
	2	2	X					EPGS	Spacecraft		1.1.1.2	
Housekeeping Data Stream	260.864	260.864	X					Spacecraft	EPGS	High-Rate RT Telemetry. 4.864 Kbps H/K on subcarrier and 256.000 Kbps playback on carrier.	1.1.2.1	
	257.216	257.216	X					Spacecraft	EPGS	Low-Rate RT telemetry. 1.216 Kbps H/K on subcarrier and 256.000 Kbps playback on carrier.	1.1.2.2	
	4.864	4.864	X					EPGS	L7 MOC	High-Rate RT Telemetry	1.1.2.3	
	1.216	1.216	X					EPGS	L7 MOC	Low-Rate RT Telemetry	1.1.3.1	
	256	256	X					EPGS	L7 MOC	SSR Playback Telemetry	1.1.3.2	
	NA	4.864		X				EPGS	L7 MOC	Replay of S-Band Telemetry Tape. The maximum rate is the same as for original transmission, i.e., 4.864 Kbps for RT telemetry.	1.1.4.1	CH10
	NA	256		X				EPGS	L7 MOC	Replay of S-Band Telemetry Tape. The maximum rates are the same as for original transmission, i.e., 256 Kbps for PB telemetry.	1.1.4.2	
Science Data Stream	150000	150000	X					Spacecraft	EPGS	Downlink from spacecraft is 150 Mbps	1.3.1.1	
	NA	NA		X				EPGS	LGS	(delivery via removable physical media)	1.3.1.2	
	11000	N/A			N/A			LPS	DAAC	Estimate of average data rate is based on L7 acquisition plan of 250 scenes per day. This is raw data rate without accounting for overhead associated with packaging.	1.3.1.3	